Vol. 2. No. 1. Price 7s. 6d.

THE

SOUTH AFRICAN JOURNAL

OF

NATURAL HISTORY

being the official organ of the

SOUTH AFRICAN BIOLOGICAL SOCIETY

with which is incorporated the Journal of
The South African Ornithologists' Union.

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Published by
THE SOCIETY IN PRETORIA, SOUTH AFRICA

London Agents:
WITHERBY & CO., 326 HIGH HOLBORN, W.C. 1.

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VOL. II. MARCH, 1920 No. 1.

REPORT OF THE COUNCIL FOR 1919.

Since the reading of the last report about 10 months have passed by, and, although the Society has steadily gone ahead, it is felt that we have not made the progress which was anticipated when once the war was over.

On the other hand, we have more confidence in the future and can now see our way clear to begin the new year with even better prospects than was possible last year.

It has been most unfortunate for the Society that our elected Hon. Secretary, Mr. Claude Fuller, was prevented through absence and illness, to give as much attention and energy to the Society as he had given the year before, and it is much to be regretted, that he has been obliged to resign from his office before the year was completed. The Society owes a great deal to his energetic work and we herewith take the opportunity of thanking him most sincerely for the work he has done, and we hope that he will soon again be in the position to support us in the various ways he can do so ably.

We are, however, glad to announce that Dr. Phillips has been kind enough to take over the Secretaryship at

once and has also promised to continue the work should he be duly elected. Seeing what a difficult task it is, and how shy we all are of taking this office, we feel sure that this election is a certainty and the business-like way in which our acting Secretary took over the work shows us what possibilities our Society may have.

Membership:—During the year we lost one member, through death. The number of new members elected this year is only 14, thus giving a total membership of 192. Of these however, 34 are in arrear for their subscriptions for 1918, and for 1919 87 subscriptions are still unpaid. The last big figure is largely due to the fact that through various circumstances, which need not be enumerated here, we were not able to publish our Journal as early as was anticipated. We had calculated to publish only two numbers this year, owing to the prevailing high price of printing, but unfortunately even the first of these numbers is now over six months in arrear, and has just left the press, and we can well understand that the Journal not being forthcoming, many members forget about their subscription. The Council on the other hand did not wish to send out reminders until the Journal was published.

We have no doubt, however, that members will realise the difficulties which beset a young Society like ours, and we hope that they will support their Council as much as they can, in order to secure success.

Although we could not expect a rapid increase in membership under the above mentioned circumstances, yet it should be understood that the welfare of a Society is determined firstly by the number of its members, and secondly by their assistance and co-operation. We feel at the present time there is not sufficient contact between the members, a condition that would be largely improved by a more regular publication of the Journal; the incoming Council should therefore endeavour to issue next year at least two numbers.

We regret to say, however, that the delay of the present number is not entirely due to circumstances outside the Society. The Editorial Committee had some difficulty in getting together sufficient material of a varied character and suitable nature, and at the same time within the financial possibilities of the Society. Even the present number is not as varied as we could wish it to be, so that each member may find something of interest, and the next number, now in hand, and which we hope to be out by April is practically all the material we have on hand for publication.

We therefore sincerely hope that now that the printing difficulties are practically at an end, members will send in their articles, so that it will not be necessary for some of the Council members to write special articles in order to give the Members a "JOURNAL"! Yet, that is what would happen should M.S. not come forward more regularly.

In connection with Publications, I may draw the attention of members to the fact, that we have now all the old stock of the S.A.O.U. Journal and that there are still complete sets available, so that members who wish to have their Journal complete, should not wait too long in ordering one.

A glance at the balance sheet will show, that there is still a fair amount of money on hand, though not less than £104 are outstanding; it should, however, be remembered that most of this is earmarked to defray the cost of printing of the present number. It is therefore hoped that members will readily respond to the reminders which in future will be sent out regularly.

The 1919 award of the Capt. Scott memorial Medal:— As will be seen in this number of the Journal, (fuller particulars appear later), the Senior medal was this year awarded to Dr. I. B. Pole Evans at a special meeting on the 15th of May. Several visitors were present on the occasion and this will no doubt have made the Society wider known.

The Junior medal has not been awarded yet, owing to the limited competition in the M.Sc. examination in Natural history subjects, and the Trustees of the Fund have therefore decided to award it in future to the best Candidate in the B.Sc., examination. It is anticipated that the first award will be made in March next year, together with the Third award of the Senior Medal.

The attached report has been received from the Hon. Secretary of the Pretoria local branch which shows that exceptionally few meetings have been held this year and also that the attendance is not as good as it used to be. It is therefore welcome news that the branch has decided to hold next year a series of popular lectures to arouse interest in natural history and to stimulate interest in the Society locally. No new local branches have as yet been formed elsewhere, though some places have a sufficient number of members to justify the existence of one or two other branches.

In conclusion, Ladies and Gentlemen, I must express my sincere appreciation of your having for the second time elected me as president of our Society. I feel sure that I have not done sufficient for the Society to warrant this token of honour, but I can assure you, that I have at any rate endeavoured at all times to promote the interest in our Society to the best of my ability.

I hope that next year will be a more prosperous year than this one has been, and feel confident that with combined efforts our Society will fill a high place in Biological research in South Africa.

CONSTITUTION.

1. The short title of the Society shall be "The South African Biological Society". The full title shall be "The South African Biological Society in which are incorporated the Transvaal Biological Society and the South African Ornithologist's Union".

2. The objects of the Society shall be:—
   (a) to advance the study of biological science and to give all possible assistance to those in South Africa who are interested in the study of natural history.
   (b) to publish a Journal of biology and natural history; also the transactions of the Society.
   (c) to advocate the preservation of the monuments of nature.
   (d) to hold scientific congresses from time to time in various centres.

3. The seat or headquarters of the Society shall be in Pretoria subject only to provisions in Article 46.

4. The Society's financial year shall be from the 1st January to 31st December and the Annual General Meeting of the Society shall be held in December.

5. The annual subscription shall be one pound sterling with an entrance fee of ten shillings and sixpence sterling.

6. The Society shall consist of Foundation, Ordinary, Life, and Honorary members.

7. The affairs, funds, and the issue of any publications of the Society shall be vested in a Council.

8. The general management of the Society, the election of Ordinary members, the essential arrangements for the issue of publications, issue of notices, etc., shall be vested in an Executive Committee.

9. The Council shall consist of a President; at least six Vice-Presidents; ten ordinary Council members, all proportionately representative of the members resident in the several Provinces of the Union and Rhodesia; an Editorial Committee of three members, one of whom shall be Editor-in-Chief; an Honorary Secretary, and an Honorary Treasurer.

10. The Executive Committee shall consist of all members of the Council resident at the seat of the Society. Five to form a quorum.

11. The Executive Committee shall have the power to elect Special Committees from any members of the Society, and to remit such powers as may be deemed advisable.

12. The President, and the Honorary Secretary shall be ex-officio members of all Committees.

13. Any vacancy in the Council shall be filled by the Executive Committee and reported at the Annual General Meeting of the Society.

14. Ordinary Meetings of the Executive Committee shall be held once a quarter. Special Meetings of the Executive Committee may be summoned by the Honorary Secretary upon given seven days notice, or, in cases of emergency instanter.

15. The Honorary Secretary shall give fourteen days notice to all non-resident Members of Council of an Ordinary Meeting of the Executive Committee, and shall advise all non-resident Members of Council of any business transacted at an Ordinary Meeting or at a special Meeting of the Executive Committee.

16. A Special General Meeting of the Society shall be called by the Council upon the written requisition of ten Members. Two weeks notice of such Meeting to be given to all Members.

17. Foundation Members shall be all Members who joined the Society prior to October, 1917.

18. Ordinary Members shall be such as are duly elected and shall be entitled to all privileges upon paying their subscriptions.
19. Life Members shall be Ordinary Members who after having had five years Membership shall compound their annual subscription by paying the sum of ten guineas.
20. Honorary Members shall be elected from persons of special scientific attainments, not resident in South Africa.
21. Honorary Members shall be nominated by the Council and duly elected by a correspondence ballot of the Council.
22. The number of Honorary Members shall be limited to ten.
23. Honorary Members shall be exempt from all contributions and shall receive the publications of the Society without charge, but they shall not be entitled to any vote in the deliberations of the Society.
24. Any Member of the Society resident in South Africa shall be eligible for election to any office.
25. Election to the Council shall be conducted by a correspondence ballot of Members.
26. The Council at the time being shall two months prior to the Annual General Meeting call for nominations from Members for the Officers for the ensuing year, and one month prior to the Annual General Meeting the Council shall send out Ballot papers to all Members which must be returned to the Honorary Secretary at least seven days prior to the date of the Annual General Meeting.
27. All nominees for the Council shall signify their willingness to accept office before being balloted for.
28. The result of the ballot for office bearers shall be made known at the Annual General Meeting and as soon as possible afterwards circulated among all the Members.

29. All office-bearers shall retire annually but shall be eligible for re-election.
30. All candidates for ordinary membership shall be proposed and seconded in writing by two members of the Society.
31. All nominations for ordinary membership are to be submitted through the Honorary Secretary who shall then send a ballot paper giving the candidate's name, and the names of the proposer and seconder to each member of the Executive Committee.
32. One black ball will disqualify a candidate for membership, but he shall have the right to appeal to the Council, whose decision shall be final.
33. All applicants whom the Executive Committee shall recommend for membership shall have due notice to that effect in writing from the Honorary Secretary.
34. Full membership may only be claimed after the payment of the Entrance Fee and the first Annual Subscription. Failure to make these payments within two months of notification of election will make the election null and void.
35. If any member after due notice sent by post to his address in December and again in February shall fail to pay his annual subscription before the first day in March, such member shall be suspended and continue to be suspended until the sum due be paid.
36. A member who has been suspended may be reinstated upon the recommendation of the Council.
37. A resignation shall only be considered as of effect when forwarded in writing to the Honorary Secretary, and in the absence of such notification, Members will be regarded as responsible for the payment of their subscriptions and other dues.
38. All Members shall receive a free copy of all the Society's publications from year of election.
39. The financial statement shall be circulated among all members as soon as possible after December 31st.

40. Every notice or any publication shall be considered as duly delivered when posted to or delivered by hand at the address of members as registered in the Society's List of Members.
41. Should the members of the Society resident at any centre desire to do so they may form a branch of the Society for the purpose of holding monthly meetings, the reading of papers, and scientific excursions.
42. The rules and bye-laws of any such local branch when formed shall not be in conflict with any Article of the Constitution of the Society and shall be subject to the approval of the Council of the Society and shall not operate until such approval has been secured.
43. The President of any local branch comprising not less than twenty members shall be *ipso facto* a Vice-President of the Society.
44. All local branches comprising not less than twenty members shall be entitled to receive from the funds of the Society a sum not exceeding Five Pounds sterling per annum to cover any expenses incurred in the calling and holding of monthly meetings. In regard to branches having less than twenty members, the amount shall be in proportion to the number of members.
45. Any scientific Society in South Africa may at any time affiliate or become incorporated with the South African Biological Society. The terms of such affiliation or incorporation shall be arranged between the councils of the two societies and to take effect when approved of by a distinct majority of members in the case of each society.
46. Any amendment, repeal, or substitution of any of the foregoing provisions, or for the making of any further provisions to the Constitution must be notified to the Honorary Secretary in writing and supported by the signatures of at least six members.

47. Each member of the Council shall receive a copy of such notice from the Honorary Secretary.
48. The Council shall submit the proposal to members by correspondence ballot and if agreed to by two-thirds of the members such alteration shall be recorded in the book of Constitution and when so recorded shall have and take effect.

SOUTH AFRICAN BIOLOGICAL SOCIETY. PRETORIA LOCAL BRANCH, REPORT OF THE SECRETARY FOR THE YEAR 1919.

The following officers were elected:—President, Mr. A. K. Haagner; Vice-presidents, Mr. R. E. Montgomery and Dr. E. M. Doidge; Hon. Secretary, H. K. Munro.

Six meetings were held during the year; in February, May, August, October, November and December. The average attendance was eleven members and four visitors per meeting.

The following is the list of papers and demonstrations:

A. K. Haagner. The African Elephant and its domestication. Illustrated with photographs.

Dr. H. H. Green and C. D. Dijkman. The Path and Rate of elimination of Arsenic.

H. K. Munro. Note on the Occurence of Fossil Tsetse flies.

C. F. M. Swynnerton. Lecture on the Habits of Tsetse flies. Illustrated with lantern slides.

Dr. E. P. Phillips. The Proteas of South Africa. Illustrated with lantern slides.

A. J. T. Janse. The Notodontidae of South Africa.

H. K. Munro. Notes on the Habits of Flies. (Diptera.)

Dr. E. P. Phillips. The value of a State Herbarium to an Agricultural Country.

A. Roberts. Exhibit of specimens of Gerbilles and Shrews.

FINANCIAL STATEMENT FOR THE YEAR ENDING 30TH SEPTEMBER, 1919.

To Printing: Journals, Taylor & Francis	£27	14	5			
" " Specialty Press	27	14	11	£55	9	4
" General, Rofail	2	5	0			
" " Buckley & v. Duyn	1	10	0	3	15	0
To S.A.O.U. Journals, shipping charges	4	19	1			
" " railage charges	1	3	6	6	2	7
Clerical assistance and typing				9	6	9
Postage				2	18	3
Advance to local branch				1	0	0
Refund, disbursements petty cash a/c, 1918				6	0	11
Advance to Scott Medal Trustees				7	19	0
Bank Charges and Commission				1	4	0
Balance at Bank a/c on 30th September, 1919				96	13	7
				£190	9	5

By Credit bal. at Bank a/c, 30th Sept., 1918	£91	4	3
Subs., £80 10s.; Entrance fees, £6 16s. 6d.	87	6	6
Sales of Journals	7	1	0
Exchange on country cheques recovered		12	8
Refund on a/c of loan Scott Medal Trustees	4	5	0
	£190	9	5
By balance at Bank a/c on 1st October, 1919	£96	13	7

Certified a correct a/c and balance.

AUSTIN ROBERTS,

Actg. Hon. Treasurer, S.A.B.S.

Presentation of the Capt. Scott Memorial Medal to Dr. I. B. Pole Evans, on 15th May, 1919.

In presenting to Dr. Pole Evans the second Senior Capt. Scott Memorial Medal as is my privilege to do, it is hardly necessary to say much about his work in South Africa or of his relationship to the Society, for with the details of this many of you are more familiar than I have ever had the opportunity of being.

From the foundation of the Transvaal Biological Society, Dr. Pole Evans was closely associated with the Society and those members who still remember the early days of this Society will know, that his laboratory was its birthplace as well as the place of meeting as long as we were a small family of about twelve members.

Nobody would have thought in those days of a meeting without the presence of Sir Arnold Theiler, Dr. Gunning, Mr. Howard and Dr. Pole Evans and the incomplete list given in the Journal of the S.A.B.S. of Dr. Pole Evans' papers read and discussed at the meetings, gives some idea of the interest he then took in the Society.

To members who are not intimate with the branch of research to which Dr. Pole Evans has devoted so many years, the following information will be welcome, especially as it is, at the same time, a short history of the ontogenesis of phyto-pathological research in South Africa.

Illtyd Buller Pole Evans received his early education at the Cowbridge Grammar School and took the degree of B.Sc., at the University College of South Wales, Monmouthshire, Cardiff in 1903. From there he went to the Selwyn College, Cambridge, and although it was his original intention to study medicine, fortunately for the study of Botany in S.A., he abandoned this idea, and took up the study of plant-pathology and mycology, under the direction of the most celebrated of English phyto-pathologists, Marshall Ward.

Second Award of Scott Medal.

In 1905 Dr. Pole Evans took his research degree at Cambridge and very soon after, on the 28th July 1905 took up his appointment in the Transvaal Department of Agriculture, Division of Botany, as assistant for plant diseases. At that time Mr. J. Burtt Davy was chief of the Botanical Division, but in Jan. 1912 Plant-pathology was separated from Botany and Dr. Pole Evans appointed as chief of the new division of plant pathology and mycology. Mr. Burtt Davy resigned in October 1913, the divisions were re-amalgamated and Dr. Pole Evans was appointed chief of the two divisions with the title of Chief, Division of Botany. In June 1907 he was elected a Fellow of the Linnean Society of London; during 1911 he was President of the T.B.S., and for many years he has been a Fellow of the Royal Society of S.A. and a member of Council of the South African Association for the Advancement of Science. In 1918 the Degree of D.Sc. was granted to him by the University of Wales on the strength of his published research work. In July 1918 he was appointed Director of the Botanical Survey of South Africa, an undertaking which he had been urging on the Government for the last ten years, and which was then put on a working basis.

When Dr. Pole Evans came to the Transvaal in 1905 no phyto-pathological work had been done, and various outbreaks of coffee rust and other diseases led to his appointment, in order that these might be investigated. The first years of his work were consequently mainly devoted to the study of rust fungi, but several other pathological problems were studied at the same time, and the amount of advisory and research work increased gradually to such an extent as to necessitate the appointment of first one, and then several assistant mycologists. It is of interest to note, that all these, who are graduates in Botany of the Cape University—now the University of South Africa—were trained in plant pathology by Dr. Pole Evans himself.

Gradually the work of the Division and the labour of its Chief extended over larger areas of botanical research, a few portions of which may be mentioned. Research work was undertaken in connection with indigenous and exotic grasses and other pasture and fodder plants; investigations were carried out in connection with indigenous plants poisonous to stock,—this in co-operation with Sir Arnold Theiler and other members of the Division of Veterinary Research; noxious weeds, and indigenous plants which could be used as sources of fibre, dye-stuffs, drugs, paper, etc., were studied; a special study of South African Aloes was made and many new species described; a large mycological herbarium was established and the study on rusts of indigenous plants is still continued; in addition to the considerable amount of phyto-pathological research work, which is still under his direction.

The latest but not least important branch, is the Botanical Survey work, of which a large amount will be done in the National Herbarium which is now attached to the Division.

I do not think that I say too much in stating, that much if not most, of this growth of Botanical research in South Africa is due to the stimulating influence of Dr. Pole Evans' energy and perseverance, and that Botanical Science owes him a great deal for the quantity and quality of work he has done.

A glance at the attached list of papers of which Dr. Pole Evans is the author will convince any one of the amount of work done by him and while presenting this medal to him to-night, we express the hope that he will be able to continue for many years his contributions to Botanical research in South Africa.

Scientific Papers.

By I. B. Pole Evans, M.A., D.Sc., F.L.S.

1. Infection phenomena in various *Uredineae* (Rept. British Assoc. for the advance. of Science. S. Africa 1905, London 1906, p. 595 — 596.)
2. Note on *Fusicladium* affecting apples and pears in Cape Colony — Trans. Agric. Journ. IV. 1906, p. 827-829.
3. The cereal rusts — Ann. Rep. Trans. Dept. Agric. for 1906-7 V. 1907, p. 163-5.
4. Coffee rusts (*Hemileia vastatrix* Berk and Br.) — Ann. Rep. Trans. Dept. Agric. 1906-7. V. 165-6.
5. The cereal rusts I. The development of their *Uredo mycelia.*—Annals of Bot. XXI. 1907, p. 441-446.
6. The South African Locut fungus, *Empusa Grylli,* Fres.—Trans. Agric. Journ. V. 1907, p. 933-939.
7. On the systematic position of *Aecidium elegans,* Diet — Rept. S. Africa. Ass. Adv. Sc. 1908, p. 252-253.
8. Bitter Pit of the Apple. — Transvaal Dept. of Agric. Techn. Bull. No. 1, 1909.
9. On the structure and life-history of *Diplodia natalensis*, n. sp. — The cause of the " Black rot " of Natal Citrus Fruit. — Trans. Dept. of Agric. Sc. Bulletin, 4. 1910.
10. South African cereal rusts, with observations on the problem of breeding rust-resistant wheats. — Journ. of Agric. Science, Vol. IV, pt. 1. 1911, p. 95-104.
11. A fungus disease of Bagworms in Natal. — Annals Mycologici, Vol. X. No. 3, 1912, p. 281-284.
12. Three Fungi collected on the Percy Sladen Memorial Expedition of 1910-11 and 1912-13 — Annals of Bolus Herbarium. Vol. 1. 1915, p. 115.

13. Note on a variety of *Kalchbremnera Tuckii* (Kalch and Mac Owan) Berk, from Grahamstown and Kentani Districts. — Records of the Albany Museum, Vol. III. 1915. p. 157.
14. The South African Rust Fungi. I. The species of Puccinia on Compositae. — Trans. Roy. Soc. S. Afr· Vol. V. 1916, p. 637-646.
15. Descriptions of some new Aloes from the Transvaal, Pt. I. — Trans. Roy. Soc. S. Africa. Vol. V. 1916. p. 25-35.
16. A new Aloe from Swaziland. — Trans. Roy. Soc. S. Africa, Vol. V. 1916. p. 603-4.
17. Descriptions of some new Aloes from the Transvaal. Pt. II. — Trans. Roy. Soc. S. Africa, Vol. V. 1917, p. 703-711.
18. A Sketch of the Rise, Growth and Development of Mycology in South Africa being Presidential Address to Section C.—S. African Ass. Adv. of Science. 1916 S. African Journ. of Science, Oct. 1916, p. 1-20.
19. A new Smut on *Sorghum halepense Nees* — S. African Journ. of Science, June 1916.
20. South African Fibre Plants, I. Ambari or Deccan Hemp *Hibiscus cannabinus* L. — S. African Journ. of Industries, Vol. I. 1917, p. 198-208.
21. The Plant Geography of South Africa. — Official Year-Book of the Union, No. 1. 1917.
22. *Novitates Africanae.* — Annals of Bolus Herbarium, Vol. II. 1917, p. 109-111.

Popular Articles.

By I. B. Pole Evans, M.A., D.Sc., F.L.S.

1. Notes on Diseases of Plants. — Trans. Agric. Journ. IV. 1905, p. 148-149.
2. Smut in Wheat, Barley and Oats, and how to prevent it. — Trans. Agric. Journ. IV. 1906. p. 389-396.

3. The Citrus Fruit Rot, caused by the blue mould *Penicillium digitatum* (Fr.) Sacc. — Ann. Rept. Trans. Dept. Agric. 1906-1907, VI. 1908. p. 60-62.
4. The New York Apple tree canker or black rot fungus in South Africa. — Trans. Dept. Agric. Bull. No. 25.
5. Potato Rot. — Trans. Dept. Agric. Bull. No. 30.
6. Anthracnose or Zwart roest of the Grape — Trans. Dept. Agric. Bull. No. 15.
7. Peach leaf Curl. — Trans. Dept. Agric. Bull. No. 10.
8. Potato Scab. — Dept. of Agric. Union of South Africa. Bull. No. 19.
9. The Powdery Mildew of the Grapes. — Dept. of Agric. Union of South Africa. Bulletin No. 9.
10. The Mildews of the Grape Vine. — Trans. Agric. Journ. VII. 1909. p. 213-217.
11. A Note on the European Apple Tree Canker. — Trans. Agric. Journ. VII. 1909. p. 217.
12. Peach freckle or black spot. — Dept. of Agric. Union of S. Africa. Bull. No. 57.
13. The Downy Mildew of the Grape. — Dept. of Agric. Union of S. Africa. Bull No. 13.
14. Black scab of warty disease of the Potato. — Dept of Agric. Union of S. Africa. Bull. No. 3.
15. Corky scab of the Potato. — Trans. Agric. Journ. VIII. 1910. p. 462-3.
16. A new disease of Citrus Fruit. — Trans. Agric. Journ VIII. 1910. p. 463-5.
17. A Fungus disease of bagworms. — Trans. Dept. of Agric. Union of S. Africa. Bull. No. 35.
18. Dik-voet, Club-root or Finger-and-Toe in S. Africa. — Dept. of Agric. Union of S. Africa. Bull. No. 39.
19. Maize Smut or Brand. — Dept. of Agric. Union of S. Africa. Bull. No. 56.
20. Smut in Kaffir corn. — Dept. of Agric. Union of S. Africa. Bull. No. 45.
21. Plant Diseases in South Africa. — Dept. of Agric. Union of S. Africa. Bull. No. 45.

22. Notes on the South African Flora.—South African Railways & Harbours Magazine.
23. The Aloes at Union Buildings, Pretoria.—South African Gardening, July 1917.

ADDITIONAL TECHNICAL ARTICLES.

The Plant Geography of South Africa, Official Year Book 1917.

On the Genera *Diplocystis* and *Broomeia*—(with Miss A. M. Bottomley, B.A.) Trans. Roy. Soc. of S.A. Vol. VII. Part 3, 1919.

Note on the genus *Terfezia*, a Truffle from the Kalahari.—Trans. Roy. Soc. of S.A. Vol VII. Part 2, 1918. p. 117 ff.

Teff Rust.—Kew Bulletin 1918, p. 228.

The Importance of a Properly Equipped State Herbarium to an Agricultural Country.

By E. P. Phillips, M.A., D.Sc., F.L.S.,
Division of Botany, Pretoria.

In the realms of science botany stands out pre-eminently as the science which comes into intimate contact with the fundamental problems of life and living things. It is at the same time the science which lends itself most readily to practical application in many economic directions. As far as agriculture is concerned, Dr. L. Cockayne, a celebrated New Zealand Botanist, remarks "that Agriculture, if it is to improve, must take full advantage of the methods and discoveries of those branches of modern botany which specially affect it

hardly needs asserting". One does not agree wholly with the latter part of this statement as every day experience goes to show that there is a lack of sympathy with, and of appreciation of the work done by the systematic botanist. The prevalent idea appears to be that he is a man useful enough to send an odd plant to for naming, but beyond this he is useless from a practical point of view. There is just an element of truth in this which obscures the other aspects from which he should be regarded, and as the "man-in-the-street" usually has not the time or the inclination to study the work done in a herbarium in relation to other branches of botanical science this erroneous idea will persist until the real value of a plant collection is proved to him.

The writer has attempted to do this in the following pages by first of all outlining the various economic results which have accrued as the direct result of botanical investigation, and then to show that the investigators in each case have had to approach the systemarist before their results can be given to the world. In other words, to show that systematic botany, i.e. the correct naming of plants, is the foundation upon which all botanical knowledge must be built. It naturally follows that if this foundation is to be secure, the State should possess at least one well-equipped, scientifically conducted herbarium in which the native flora can be studied and where also representative collections of plants from other countries are kept for reference and comparison.

In compiling this paper the writer has drawn freely upon data scattered in various botanical publications, a list of which is appended, and has sometimes quoted verbatim the remarks therein, but this needs no apology as the scope of this paper is to bring together and place before the public facts not generally available to the ordinary man.

If the perusal of these few pages results in the more sympathetic appreciation of the work done in a herbarium to further, not only knowledge, but the welfare of mankind, the slight labour entailed in preparing this paper will be amply rewarded.

The Scope of Botanical Science.

Botany is the science which deals with plants. It aims at knowing everything possible about them, and in recent years the science has made such strides in so many directions that botanists have almost been compelled to devote all their time to, and specialize in, one branch of the subject. The general structure of the plants; the functions of the various organs; conditions necessary for maintaining the life of the plant; their relation to other forms of plant and animal life; their uses; mode of dissemination; their present distribution over the earth, etc., are all aspects from which the botanist approaches the study of plants, and the investigation of botanical problems. For the sake of convenience the science is divided into more or less definite groups as follows:—

1. **Morphology.** Is the study of the external form and structure of plants.
2. **Economic Botany.** Is the investigation of the uses of plants to man.
3. **Systematic Botany.** Deals with the classification of plants.
4. **Anatomy.** The detailed study of the internal structure.
5. **Histology.** A study of the plant cells and minute structure.
6. **Physiology.** The functions of the various plant organs.
7. **Ecology.** The relation of plants with other plants or animals to their physical environment.
8. **Geographical Botany.** The distribution of plants.
9. **Vegetable Pathology.** The study of the diseases of plants.

It must not be inferred, however, from the above grouping that these sub-divisions are complete in themselves; they are interdependent and in the solution of any botanical problem the aid of one or more of them may have to be sought. In the same way as the various branches of Botany are dependent on one another, so are the various Sciences. As the Botanist has to seek the co-operation of the Chemist, the Physiologist, the Zoologist and the Bacteriologist, so have these Sciences need of botanical assistance in many problems which confront them.

The Value of Botanical Science.

The fact that the very existence of man on the earth is dependent on the vegetation hardly needs any proof and yet we are apt to lose sight of this fact. Those of us who live in towns and are only accustomed to be served with the finished articles of everyday use—our food, clothing, etc., hardly ever stop to realise the sources from which these are derived.

Directly or indirectly we all live on the products of plants and the subject of Economic Botany therefore becomes of prime importance. From various plants we obtain our gums, resins, rubber, dyes, fibres, drugs, timber, foods, etc., and the further investigation of sources of supply is a matter of moment. This work is being carried on in all progressive countries of the world. New plants are being constantly discovered which yield some useful product, they are introduced into cultivation and mankind benefits. The number of such plants is so large that it would be out of place to give a list of them here.

Not only are we dependent directly upon certain plants, but indirectly the vegetation of a pastoral country affects us, as the quality and quantity of our milk, butter and meat is affected by the state of the pasture. Here again Botanical Science must be relied upon for solving the

many problems concerned. It appears to be fairly certain that the veld in many parts of South Africa is deteriorating; this affects us as a nation, so that it becomes imperative to know what is happening in these cases. It is a problem primarily for the botanist and until he has investigated the causes which bring on these changes no remedy can be suggested. Many other problems connected with the veld, such as grass-burning, overstocking, poisoning, the value of native plants and grasses as stock food all await and demand the aid of Botanical Science.

I have indicated above the direct practical importance botanical science is and may be to mankind. but, botanical investigations which are undertaken with no utilitarian object in view should not be looked down upon, on the other hand they should receive every encouragement. As the late Dr. H. H. W. Pearson wrote "Research is, or should be, undertaken with the single object of discovering truth, regardless of the consequences. These however, may at any time assume a practical and economic value which no one has been less inclined to expect than the investigator himself". Dr. L. Cockayne also remarks "There is hardly any ecological research, however non-utilitarian it may seem, which is not dealing with actual or potential farm lands. Thus few non-economic ecological studies lack entirely the economic aspect. Agriculture, however, does not depend upon the slow process of nature. If the reactions of a plant to the outer world be sufficiently known, it should be possible to so change the conditions of its environment that its frequency in an association could be so increased or decreased as its agricultural value may suggest".

In the Kew Bulletin for 1897 is a translation of an extract which appeared in the *Journal des Debats* for March 20th. 1897 to the effect "that a nation that desires to form colonies will find that the conquering of the territory is hardly the beginning of her task. The resources of the country must be studied and appraised,

the agricultural and geological map of the land must be prepared; the soil must be analysed, native plants catalogued, foreign ones introduced, the best selected, and finally methods adopted to in every way advise and assist the colonists". The importance of Botanical Science as an aid in opening up a new country is here fully realised. We also have an example in East Africa where the Germans soon after their occupation published a bulky volume on the Botany of German East Africa, containing not only a systematic account of the flora but also classified information in the various groups of economic plants. This information was the outcome of assiduous collection by their botanists.

The accusation of lack of appreciation of the value of Botanical Science was made against the Cape by men who had extensive experience of the benefits conferred by Botany in various parts of the world and were competent to pass judgement. For instance Mr. J. S. Gamble, F.R.S., a distinguished Indian botanist and forester who visited the Cape in 1890 remarked on the little interest taken by the Colony in Botanical Science, which points to a want of appreciation of the benefits a really well conducted botanical headquarters station can confer on a country which is, after all, chiefly agricultural. Likewise the Director of Kew in 1895 wrote "at the present moment Cape Colony is the only important British Possession which does not possess a fully equipped Botanical Institution—it has no central authority dealing with the practical aspects of the science of botany". Since then conditions have changed somewhat but the value of the Science is still far from being fully recognised.

Some botanical problems in South Africa.

The Union Government has recently sanctioned a Botanical Survey of the country, which should result in many discoveries of economic importance. Of prime

importance is a close study of the veld undertaken in a scientific manner on the most up-to-date ecological lines, and such investigation is bound to reflect for good on the prosperity and welfare of South Africa. Quoting again from Dr. Cockayne "once the different classes of agricultural land are segregated for the next scientific process—intensive ecological investigations and experiment—then it can be truly said that the era of the New Agriculture has commenced and that the day of intensified national prosperity has dawned". This particular field of botanical investigation is so closely connected with the future of all agricultural and pastoral countries and its possibilities so great that it would require more space than is at my disposal to enlarge on the results which could accrue.

In the Union there are about 150 species of flowering plants which live as parasites on the native vegetation. At any time any one or more of these parasites may become a menace to the farming community. One of them. the Witchweed or "Rooibloem" (*Striga lutea*) has caused much damage to the mealie crops. If we believe in the axiom that "prevention is better than cure" it is better to commence botanical investigations on these plants now, their classification, distribution, mode of dissemination, the host plants affected by them, etc., so that if an outbreak did occur the man investigating the particular problem would have some data on which to start work. Such preliminary work falls within the scope of the herbarium.

In South Africa we have over 12,000 species of flowering plants and quite a large number of these are known or supposed to possess virtuous or poisonous properties. The investigation of the native plants with the aid of the Chemist from this point of view opens out all sorts of possibilities. Very little real scientific work has been done along these lines and as Dr. Juritz pointed out in 1915 "South Africa still remains as indifferent as in Pappe's day to the Pharmacological possibilities of its

almost inexhaustible flora" Great industries have been built up in other parts of the world, to cite one instance the Cinchona industry of India and Java, through the investigations of native uses of plants. Many papers have been published in South Africa on the plants used by the natives in medicine, many of these plants are probably worthless but each species used medicinally justifies a close examination before it can be said to be useless. This work requires a thorough co-operation of the chemist with the botanist on one hand, and with the physiologist on the other.

Not only is it probable that very many valuable medicinal plants will be found among our native flora, but it is more than probable that other useful products will be discovered which may develop into profitable industries. More than ever is attention being paid to vegetable products. In England in 1916 the Council of the British Association asked the Sectional Committees to meet to consider what could be done in their respective Sections to meet the problems which would arise after the war. In the Botanical Section was a suggestion embracing the more extended and thorough study of those plants of economic value which are native of or capable of being cultivated in Great Britian or other parts of the Empire. Dr. A. B. Rendle, Keeper of the Botanical Department of the British Museum, with the help of Kew drew up a list of economic plants.

A number of these plants or their allies occur in South Africa and the following list shows a few that might open up a profitable field of investigation.

Linum (flax.) Seed and oil imported into Great Britain in 1913, £2,836,986; 4 species occur in S.A.

Trichelia emetica. Seeds valued at £8 to 9 per ton. This tree occurs in South Africa.

Eugenia caryophylla. (Oil of Cloves). There are at least 5 species of *Eugenia* native.

Pelargonium spp. (oil of Geranium). 2 species *P. radula* var. *odoratissimum* Soland. and *P. capitatum* Ait. are cultivated in the south of France, Spain and Algeria. The value of the oil in 1915. was from 9/6 to 35/- per lt. We have over 170 species of *Pelargonium* in S.A. and the above 2 species are both native of this country.

Andropogon schoenanthus L. (Ginger-grass-oil). The oil in 1915 was worth 5/6 to 6/- per lt. This same species of grass occurs in S. Africa.

Acacia sp. (gum Arabic). In 1915, £255,092 worth was imported into the United Kingdom. In S.A. we have over 25 species of native acacias.

Mimusops bidentata (Balata). A valuable industry in New Guinea. In S.A. there are 11 species of *Mimusops* native.

Peucedanum graveolens Bth. & Hook. f. (Dill. Fruits.) The genus *Peucedanum* is represented in S.A. by at least 17 native species.

Rhamnus purshiana DC. (*Cascara sagrada*). Two species at least of this genus occur in S.A.

Erythroxylon cica. Lawk. (Cocaine). This genus in S.A. has at least 2 native species.

Cassia spp. (Senna). About 6 species of *Cassia* are native.

Ipomoea purga Hayne (Jalap). This genus is represented in S.A. by over 50 native species.

Urginea scilla Heink. (Squill). There are over 25 species of *Urginea* native.

Baphia nitida Lodd. (Camwood). This genus is represented in S.A. by 1 or 2 species.

Terminalia chenula Bth. (Myrobalans). A dye and tanning material. In 1917, £292,297 worth was imported into the United Kingdom. We have a species of *Terminalia* native.

Rhus spp. (Sumach). In 1915, £84,000 worh came into the United Kingdom. In S.A. there are over 50 species of the genus.

Quite apart from those included in the above list, we have in South Africa many plants of undoubted value.

The few mentioned below have been investigated and reported on by the Imperial Institute. *Asclepias fruticosa, Hibiscus cannabinus, Sida rhombifolia, Sansevicra spp.* produce good fibre while gums have been obtained from species of *Acacia* and *Combretum*. Recently a good report was received on the oil produced from seeds of *Pappea capensis*. Some species such as *Elephantorrhiza Burchellii* and *Rubia cordifolia* produce dyes of good quality. Drugs are obtained from species of *Barosma* (Buchu), *Aloe* (aloes), *Datura* (hyoscyamine). Many of our grasses such as Tambookie grass (*Cymbopogon nardus* var. *vallidus, Cymbopogon hirtus*, etc.) produce a good pulp from which paper can be made. From many plants hats, baskets, brooms, etc., can be made, and there are possibilities of the preparation of acetate of lime, acetic acid, acetone, methyl alcohol, and wood tar from the distillation of waste wood of our forests.

The Position of the Herbarium in Botanical Science.

In the foregoing pages the writer has attempted a short and very general sketch of the scope and value of Botanical Science and some of the problems to be solved in South Africa with the aid of the botanist. This leads up to the role played by the Herbarium in Botanical Science. A Herbarium, one need hardly explain, is a collection of dried plants properly classified and named and where the flora of any part of the country may be studied. Not only is the herbarium a repository for a collection of plants themselves but it is a place where

botanical investigators, collectors, and travellers may obtain all the information available about a particular plant. The Herbarium is a working tool and a record without which an agricultural country is hopelessly handicapped and is as badly off as a man in business who refuses to take stock or keep accounts. This apt illustration was made by Dr. Rendle of the British Museum. Whether one considers botanical science in general or the economic aspect in particular it leads back to the first principles—the study of the native flora—in other words, the upkeep of a Herbarium. The late Prof. Pearson wrote in 1910: "the foundations of all botanical investigations, as well as of all those researches into the problems of plant life which fall within the respective provinces of the chemist, the forester, and the agriculturist, is a knowledge of the native vegetation." This statement shows that he regarded the herbarium as a necessary adjunct to all botanical knowledge.

Prof. F. W. Oliver of the London University writes in the same strain asserting that "it is hardly necessary to emphasise the importance of having attached to every district an expert systematic botanist. Very slight specific or varietal differences between allied plants are often of critical significance in matters of exploitation, and it is of fundamental importance, when a given plant is found to be adapted to a particular purpose, that we should know how to recognise it with certainty."

The writer has received letters from eminent botanists in other parts of the world on the subject of the importance of herbaria and he may be allowed to quote their remarks here.

The Keeper of the Botanical Department of the British Museum in a recent letter to the writer says: "If the natural resources of a country are to be developed the first thing is to find out what they are and then set up a standard collection for future reference." Here Dr. Rendle intimates that he considers the herbarium essential to economic work. The Assistant Keeper of the

Royal Botanic Gardens, Edinburgh, Scotland, writes: "In the newer countries, where progress is being made in agricultural research, the need of an adequate library and herbarium is realised and as a rule is being supported with the resources of the State." Dr. Wm. Trelease, formerly Director of the Missouri Botanic Garden, and now Professor of Agriculture at the University of Illinois America, remarks: "When I came to the University of Illinois after establishing for research purposes a great herbarium at the Missouri Botanical Garden, I supposed that my days of herbarium accumulation were ended. I was hardly established here, however, when graduate students in agriculture began asking me for work in special subjects that can be studied only by the use of large and authentic herbarium collections." Dr. A. J. Ewart, the Government Botanist at Melbourne, Australia, writes: "No country can of course be regarded as civilized and self-supporting from the point of view of botanical science unless it maintains a herbarium. A properly equipped herbarium has the same relation to botanical work as a Bureau of Standards has to Physical Science or as a public library has to the education of the community," while the Government Botanist at Sydney remarks: "We know, that the herbarium, of which the Museum is mere adjunct, is absolutely necessary for the study of plants, but a herbarium is not an institution that the public visit as they do an art gallery, since it is of the character of a workshop or a laboratory; nothing very attractive to the casual observer, and therefore he does not know that it is vital to an accurate knowledge of the economic vegetation." Dr. J. J. Smith, Chief of the Herbarium at the Buitenzorg Botanic Gardens in the Dutch East Indies writes in a similar strain to the above and points out that several publications on the economic plants of Java would not have been possible without reference to the herbarium. Dr. L. Cockayne, who has done so much for the agricultural development of New Zealand, writes: "the economic value of a her-

barium is being brought home to me daily, now that I am engaged on economic research."

The above are more or less general statements to the effect that the herbarium is essential to all Botanical progress but many specific instances can be given of the direct connection between various vegetable industries and the correct naming of plants. In 1915 Mr. N. E. Brown, then on the Staff of the Kew Herbarium, undertook the naming and describing of all the known species of the genus *Sansevieria,* many of which are cultivated in the tropics for their valuable fibre. The quality of the fibre produced from the different species varies and as the market value of the fibre varies several pounds per ton in accordance with the quality, it follows that it is of the utmost importance to know and recognise the species producing the best quality. Many species of *Sansevieria* resemble one another so much that only a trained botanist with the resources of a herbarium and library at his disposal is able to distinguish them. His knowledge then becomes of great interest to the planter who will be saved perhaps large sums of money and much valuable time if he first ascertains from the herbarium that he is cultivating the best species. One of the large industries of Australia is the production of Eucalyptol oils from the native species of *Eucalpytus.* Although this industry has been long established in Australia, the authors of a work on "A Research on the Eucalyptus" published in 1902 state that "although this research covers such an extensive range in regard to the Eucalyptus yet, if one thing more than another is brought out, it is that the study of these trees is only commencing. The enormous amount of work necessary to follow up the clues already obtained points to the necessity of many more workers, both botanical and chemical, entering this field of research." This is also an illustration of the immense practical value of the correct classification and naming of economic plants; a work which can only be done in the herbarium. The close association of chemists

and botanists is also well exemplified; the former analyses the products, the latter classifies the various species and is able to advise as to the best kinds to be exploited. The authors further state that "the evidence appears conclusive that any effort expended upon particular species will be rewarded with corresponding results, providing our nomenclature as here published be followed."

The United States National Herbarium publishes many papers dealing with the correct classification of the native plants many of which have an important economic bearing. There the cardinal principle is fully realised that the first procedure when a new source of any vegetable product is suspected is to know all botanical details about the group to which it belongs and the preliminary step to this knowledge is the classification and naming of the various species. When rubber exportation from Central America became an important industry a tree known as *Castilla elastica* was thought to be a source of supply. This tree was introduced into cultivation and was widely experimented upon with varying results and a large amount of capital invested in plantations, most of which failed to justify the expectations of the investors. The behaviour of the tree in cultivation led to the suspicion that more than one species was being grown. Here the aid of the systematic botanist had to be sought and the genus monographed "as a preliminary step to the study of questions relating to the availability of the species as rubber producers."

In British Guiana two of the staple industries are the production of rubber and balata. As early as 1880 an investigation of the various kinds of latex-producing trees scattered throughout the vast forests of British Guiana was commenced by the Government Botanist resulting in many valuable species being brought to the notice of the producers.

The danger of not preserving specimens of economic importance, with information about them, in herbaria

is well exemplified in the following instance. Some years ago a valuable timber which possesses the property of resisting the attacks of boring molluscs was exported from British Guiana to the West Indies and used for piles in the construction of jetties, etc. Apparently no record of the species of the tree was kept at the time, and it is stated that its identity has been lost, and that further consignments are unobtainable in consequence. With proper care and organisation such occurrences should be impossible.

Such facts as the above could be multiplied indefinitely if space permitted but the few illustrations cited will be sufficient to show that the systematist investigating a group of plants in the herbarium, sifting and classifying evidence furnished by collectors, the results of the chemist's investigations and any other item of information he may have acquired from odd sources, is quietly but surely laying the foundation for other lines of botanical investigation.

The writer has tried to show the great importance to agriculture of ecological studies, but without the herbarium and systematist, whom he must consult, the ecologist could hardly publish his results. They would resemble a geographical description of a country with the names of the towns, villages, mountains, and rivers omitted.

If one considers also the ravages due to injurious parasitic fungi and bacteria, the need for scientific investigations is again apparent. Marshall Ward, a famous English Mycologist stated that Coffee-leaf disease caused by the fungus *Hemileia* cost Ceylon over one million pounds sterling a year for several years. In S. Africa we know of the destruction caused by Citrus Canker. Problems of this nature are for the Mycologist to solve but as some of these injurious fungi also live on native species of plants, the Mycologist must obtain the aid of the systematist for the identification of native species of host plants, as a knowledge of these may prove a vital factor

in methods employed for combating the disease. Dr. W. M. Borthwick states that "America in 1912 had a vote of £4,000,000 for their pathological section and employs a staff of 12,480 men and women, 600-700 of whom are engaged in scientific research. The money appropiated for the Department in all its branches of activity would amount to £4,514,003. In spite of the magnitude of this sum it is regarded in America as an investment, and not an expenditure".

The Botanical Museum.

No herbarium is complete unless it possesses a botanical Museum. The main object of the Museum is to show the practical applications of botanical science, but it is also necessary for the preservation and exhibition of such botanical objects as cannot be kept in the herbarium. The preface to the "Guide to the Museum of Economic Botany" of Kew sums up the objects of botanical museums so concisely that I quote from this in full. "They (i.e. Botanical Museums) teach us to appreciate the general relations of the Vegetable World to man We learn from them the sources of innumerable products furnished by the Vegetable Kingdom for our use and convenience, whether as articles of food, of construction and application in the arts, of medicine, or curiosity. They suggest new channels for our industry; they show us the variety in form and structure presented by plants. and are a means of direct instruction in most important branches of useful knowledge. We see from them the particular points upon which further information is needed. especially as to the origin of many valuable timbers, fibres and drugs, in order to perfect our knowledge of economic botany, in brief, the Museum shows us *how little,* as well as *how much,* we know of the extent to which herbs, shrubs and trees contribute to our necessities, comforts, and numberless requirements".

The economic Museums at the Royal Gardens, Kew, are by far the most extensive in existence, but large botanical

Museums have been built in most countries in conjunction with the national herbaria.

At the Division of Botany, Pretoria, there is the nucleus of a very fine economic Museum but owing to lack of suitable accommodation this is incapable of expansion.

Herbarium Institutions Abroad.

Every civilized country in the world maintains at least one well equipped herbarium. The Kew Herbarium, probably the largest in existence, contains over 2,000,000 mounted sheets and has been largely responsible for the development of the various plant industries in the British Empire. The work of Kew is too well-known throughout the world for any comments to be made here. In Germany the herbarium at Berlin has been the centre of activity for matters relating to economic botany in her colonies and in this respect is the counterpart of what Kew has been to the British Colonies.

In Australia there are two National herbaria, one at Melbourne containing about one million and a quarter sheets of specimens and a library of twelve thousand volumes. At Sydney there is also a large Botanical Herbarium, housed in a suitable building. In 1897, the U.S.A. had the following staff:—

Division of Botany in the Department of Agriculture,

(1). The Chief of the Division engaged in work upon the native plant resources of the United States and upon the geographical distribution of plants.

(2). A Chief Assistant who had special charge of seed investigations and the laboratory equipped for that purpose.

An Assistant each in charge of—

(3). all the matters relating to weeds.

(4). the pharmacological laboratory, who conducted investigations on poisonous plants.

(5). photographical and anatomical work and was also in charge of experiments on the germination of weed seeds.

(6). the greenhouse and outdoor tests of seeds and of the cultivation of native foods and other economic plants.

(7). experiments in seed selection and the effect of various chemicals upon germination.

(8). laboratory germination tests.

(9). A field Assistant.

(10). An artist to the Division.

Besides the above, the Herbarium had a staff of ten excluding the Curator, and is at present housed in a fire-proof building in the Smithsonian Institution. Unfortunately the writer has been unable to obtain any information about the growth of the Herbarium and the Division since 1897 ,but even at that date, over 20 years ago, the Division of Botany of the United States was an establishment equipped with the best scientifically trained men obtainable, and with the best modern appliances for the investigation of agricultural botanical problems. The Indian Government supports a large herbarium at Culcutta which is housed in a fire-proof building.

The above are a few of the large herbaria of the world, but every country in which agriculture is pursued or which exploits the native vegetation, has built up a reference herbarium illustrating its flora. To cite two such cases, mention might be made of the herbarium at Buitenzorgt in Java, and at Manilla in the Island of Trinidad.

SUMMARY.

To summarise briefly what has been written in the foregoing papers it has been shown that the science of botany is of great importance to the welfare of mankind. In S. Africa we have many problems awaiting solution with the aid of botany. The writer has given the views of eminent botanists on the value of plant collections and quoted some examples showing the direct importance the

correct naming of plants may have. The scope of the botanical Museum has been briefly outlined and mention made of some of the larger herbaria of the world.

The conclusion we come to is that no matter what branch of botanical science is undertaken the investigator in that particular branch must sooner or later consult the herbarium. The herbarium is not a perishable thing. With proper care and management the collection will last almost indefinitely. In Lyden is probably the oldest herbarium in the world; it was established by Rauwolf in 1576 and is still in good preservation. It will be seen then that the data accumulated in our herbaria to-day will benefit future generations in the same way as we are to-day deriving benefits from botanical collections of men who laboured before our time.

The foregoing the writer trusts will show the really practical value of a herbarium to the State, and that every effort should be made to preserve its present contents and foster its future development.

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Some changes in Nomenclature of South African Ascomycetes.

By Ethel M. Doidge.

A number of publications inaccessible during the war have recently been received in the Agricultural Department Library; amongst these are the Annales Mycologici from 1913-1919, our numbers being previously complete only to the end of 1912. A number of valuable papers on the Ascomycetes have been published during this period by Theissen and Sydow, and these necessitate some changes in nomenclature in certain fungi described from South Africa.

The genus *Meliola* Fr. comprised a large number of species, some with and some without mycelial and perithecial setae. (S.A. Jour. of Nat. Hist. 2.) The genus *Meliola* is now restricted to species with a hyphopodiate mycelium and with mycelial or perithecial setae; a new genus *Irene,* Theiss & Syd. Has been established for species without setae, (Ann. Myc. 15. (1917.) 194.) the type being *Irene inermis* (K. & Cke. sub. *Meliola*) Th. & Syd.

The following South African species are affected by this change of nomenclature:—

Irene puiggarii (Speg.)

Syn. *Meliola Puiggarii* (Speg.) Fung. Puigg. n. 228.

On various *Rosaceae.* Trans. Roy. Soc. South Africa 5. (1917). 723.

Irene gloriosa Doidge
Syn. *Meliola gloriosa* (Doidge.) Trans. Roy. Soc. South Africa.
On *Celastrus cordatus* 11565.

Irene natalensis Doidge
Syn. *Meliola natalensis* (Doidge.) Trans. Roy. Soc. South Africa 5. (1917). 724.
On *Doryalis tristis,* 8980.

Irene Podocarpi Doidge
Syn. *Meliola Podocarpi* (Doidge.) Trans. Roy. Soc. South Africa 5. (1917). 725.
On *Podocarpus Thunbergii* 1748.

Irene speciosa Doidge.
Syn. *Meliola speciosa,* (Doidge.) Trans. Roy. Soc. South Africa 5. (1917). 726.
On *Gymnosporia* sp. 1740.

Irene atra Doidge.
Syn. *Meliola atra,* (Doidge.) Trans. Roy. Soc. South Africa.
On *Eugenia* sp. 11594.

Irene scabra Doidge
Syn. *Meliola scabra,* (Doidge.) Trans. Roy. Soc. South Africa 7. (1919). 194.
On *Trichocladus crinitus,* 9064.

Irene Peglerae Doidge
Syn. *Meliola Peglerae,* (Doidge.) Ann. Bolus. Herb. 2. (1918). 109.
On *Anastrabe integerrima* 2363.

Irene Hendeloti (Gaill.)
Syn. *Meliola Hendeloti,* (Gaill.) Le Genre Meliola, 49.
On Nuxia floribunda 1776.

Irene Strophanthi Doidge.
Syn. *Meliola Strophanthi,* (Doidge.) Trans. Roy. Soc. South Africa 6. (1917). 729.
On *Strophanthus speciosus* 1781.

Irene glabra (Berk. & Curt.)
Syn. *Meliola glabra,* (Berk. & Curt.) Le Genre Meliola 59.
On *Canthium,* sp.

Irene inermis (K & Cke.) Syd.
Ann. Myc. 15. (1917). 194.
Syn. *Meliola inermis* (K. & Cke.) Grevillea 1880. p. 34.
On *Buddleia* spp.

Irene ditricha, (K. & Cke.) Doidge.
Syn. *Meliola ditricha* (K. & Cke.) Doidge. Trans. Roy. Soc. South Africa 5. (1917). 728.
Asterina ditricha (K. & Cke.) Grevillea 1880, 32.
On *Celastrus* sp. (Wood No. 3).

The numbers quoted are those of the cryptogamic section of the National Herbarium, Pretoria.

The genus *Meliolaster* described from South Africa (Trans. Roy. Soc. South Africa) was previously described by Theissen [(Ann. Myc. 11. (1913). 499 & 15. (1917). 421.)] as *Amazonia;* the name *Meliolaster* must therefore be dropped. There can be little doubt that the South African species described as *Meliolaster Mackenzii* is identical with *Amazonia asterinoides,* (Wint.) Theiss.

The Wattle Plantation — The effects of the Present methods of Wattle Growing on the Insect Problem.

By C. B. Hardenberg, M.A.

Introductory.

The investigation of the insects injurious to the Black Wattle, *Acacia mellissima*, Wild., is a very large subject and even a mere enumeration and short discussion of the various species involved would carry the length of this paper far beyond reasonable limits. I will therefore confine myself to a discussion of the influence of the existence of the large wattle plantations on the insect fauna and how the present methods of wattle growing affect the insect problem.

Effect of the establishment of wattle plantations on the Insect fauna.

Before the introduction of the Black Wattle there existed large areas of thorn bush veld, dotted over with various species of Acacias and Mimosas, sustaining a host of insects, native to the country, but which, partly on account of the comparative sparsity of the trees and their scattered position, could not increase to such an extent as to threaten entire areas with extinction. A balance between injurious insects on the one side, and parasites and limits of food supply on the other side, had been established and was apparently being maintained with slight fluctuations. Even now this is the case, for notwithstanding the enormous numerical increases of the various insects, we find that the native thornbush is not seriously affected: a wholesale infestation in one season being speedily reduced to normal conditions.

With the advent of the large wattle plantations this balance of nature was suddenly disturbed. Thousands of acres of native thornbush and other vegetation were being destroyed and replaced by the black wattle, a congener of the majority of the native trees, which originally formed a breeding place for many of these insects. The change from the old to the new food plant therefore was quickly made and on their new feeding ground they found conditions so much more genial that their increase was extremely rapid. The conditions which had previously prevented their breeding uninterruptedly had been removed, in so far that now there was an unlimited food supply with a greater protection against parasites and other natural enemies, these being the main causes for the phenomenal increase of the wattle insects during the last decade.

As proof of my contention I give here a comparison between the condition of the Wattle Bagworm, *Acanthossyche junodi*, Heyl., found in the thornveld and the same species in the Wattle plantation. The former was taken under its most favourable conditions, namely from a tree which had been infested for the first time, (no old bags of previous seasons were found on the tree), the latter under the most unfavourable conditions. i.e. from a plantation which had suffered from bagworm infestation for four successive seasons. For reasons which are not within the scope of this article, the conditions become more and more unfavourable for the bagworm with each infestation of the same block. As a third example I give the conditions of this same insect as found in a plantation of young trees, infested for the first time.

Average size of bag:—

(A). male 30 m.m., female 40 m.m.

(B). male 47 m.m., female 54 m.m.

(C). Practically the same as B.

Proportion of the sexes, as indicated by the pupae:—

(A). males 28%, female 5%.

(B). males 25%, females 20%.

(C). males 40%, females 25%.

Parasites:—(A). 52%; (B). 9%; (C). 19%.

Fungus disease.—(A). 3%; (B) 18%; (C) 3%.

Other diseases.—(A). 10%, (B). 33%, (C). 10%.

Thus we find the mere presence of large wattle plantations has the following effects:—

(a). Producing more vigorous individuals, on account of the unlimited food supply. This in turn favourably affects the reproducton, as the number of eggs laid by one individual depends entirely upon its size and vigour, ranging from about 450 to 3,000.

(b). A decrease of parasitism. The parasitic wasps and flies are lovers of sunshine and have better access to the bags on the isolated thorn trees than inside the large blocks of wattle trees.

(c). To balance this there is an increase in the number of bagworms killed by fungus and disease, but this becomes only apparent after successive generations of bagworms in the same plantation. In the young plantation (C), where the canopy has not yet been formed and the conditions thus approach those found in the thornveld, with the exception of the unlimited food supply, the percentage of diseased and of parasitised individuals is approximately the same as in the thornveld.

It is also most probable, but no definite data have been secured, that the insectivorous birds, known to prey on the bagworm are also less numerous inside the plantations than outside, which would favour the increase of the insects still more.

There is yet another point to be considered. On account of the destruction of the native vegetation many other insects, usually living on the grass and low her-

bage, have been forced to look for a change in diet and are now becoming true tree feeders in the plantation. As examples may be mentioned various *Arctiidae, Psychidae,* and *Tineid* and *Cossid*-like bagworms.

Effects of the present methods of wattle growing on the insect problem.

Now let us consider what the average wattle grower, having increased his insect enemies beyond measure, does to offset this by his methods of wattle growing. We will therefore follow a plantation from its start to the harvesting and preparation for the second crop.

One of our prominent wattle growers, in a recent article in the Agricultural Press published the following sarcastic comment on the methods in vogue. " A common idea of wattle growing appears to be "breaking up the land, anyhow, planting the seed, anyhow, and "leaving the trees to look after themselves, also anyhow", an indictment which still applies to a great many,—yes, I should almost say the majority of wattle growers, if not entirely, at least in part. Of course, the old method of sowing the seed broadcast, with or without sufficient preparation of the soil, and leaving the trees entirely to look after themselves is, entomologically speaking, entirely hopeless, and is now rapidly becoming obsolete, being abandoned in favour of other methods which promise a better chance of success from a commercial point of view, but between this and the newer procedure all stages may still be found. We will therefore discuss only the latter advanced ideas, bearing in mind that, the farther removed from these new methods, the more hopeless the style from the point of the economic entomologist.

Preparing the land.

It is now advised to carefully plough the land at such a time as will best ensure the eradication of grasses and weeds, especially those of the perennial kind. This ploughing can be done in the late fall or early spring,

the former being advised as the better of the two. This thorough preparation is highly commendable as the soil at that time will throw up a great number of subterranean larvae and pupae, leaving them to perish by the alternate heat and cold and exposing them to insectivorous birds. But I would go a step further, namely advise the destruction of the termite nests on the land to be put under wattles and for a certain distance—say half a mile—around it, as the young plantations are often damaged by these insects. I have seen blocks of young trees whereof fully five per cent. had been killed by termites.

Another precaution which is usually disregarded is to prevent the surrounding fields from becoming a breeding place for various insects which might attack the young trees as they come up. The easiest way to get rid of these would be by burning in the late fall. I have in mind as an example a field which had to be replanted twice, the young plants having been eaten off by cutworms, (*Euoxoa segetus*), which had been bred on the veld immediately surrounding the prepared ground. The moths, emerging there, while the grass was still dry, laid their eggs on the green wattles just coming up and the caterpillars made short work of them, eating the plot completely bare.

Preparing the seed and planting.

To ensure rapid and equal germination, the seed is boiled or scorched, to soften or crack the seed coat. This would destroy any insect with which the seed might be infested and is thus, entomologically speaking, a sound procedure. Very few insects have been found infesting the wattle seed, the principle offender being species of *Rhynchophora* of the genus *Apien*. Unfortunately, the boiling of the seed, while effective as a sterilising process, does not prevent later infestation, and cases are known where repeated sowing had to be done on account of the beetle having burrowed into the soil after the seed.

To facilitate the planting of the sticky wet seed, it is advised to mix it with soil, sand or ashes, etc.—the latter method beng preferable as the ashes may act as a repellant.

The old method of having the trees standing broadcast is now fortunately being abandoned in favour of the row system, which is a great improvement. But as to the distance between the rows there is still a great difference of opinion. While the latest advice is to plant the trees in rows twelve feet apart, many growers still have the rows originally 6 to 8 ft. and after a few years, take out every other row. This ensures some return in bark and gives the remaining trees more room for further development. This practice is however to be condemned from an entomological point of view for the following reasons:—

The closer the rows the less room for cultivation of the soil between them. Cultivation can only be done up to a certain distance from the base of the trees and after the removal of the middle row the stumps remaining prevent this central part from being worked. Cultivation, especially if done in late fall or early spring, will throw up and expose a great number of larvae and pupae of such insects as feed on the roots of the trees, especially of the various species of cockchafers, which are then near the surface ready for emergence in November.

The mass of brushwood and stumps cannot be burned as this would endanger the plantation and is thus left lying. These dead branches and stumps soon attract a host of wood boring insects, and these breed there to the danger of the standing trees. We have bred several species from such material, which have been found to infest the living trees later.

The presence of this brushwood and stumps effectively prevents the manipulation of any apparatus which might eventually be used for the control of the insects on the remaining trees.

Subsequent cultivation is made impossible.

If the rows stand closer than twelve feet, it becomes very difficult, and in some cases where crooked trees abound, impossible, to move through the lanes with the waggon carrying the machine for bagworm destruction.

These few reasons are sufficient to prove that the method of close planting, followed by the removal of alternate rows is from an entomological standpoint unsound.

Following the plantation in its growth, we find that, while some cultivation is being done to keep down grasses and weeds during the first two years, or until the trees have become fair sized and the canopy begins to form, that after this, until the time for stripping arrives the trees are being left to take care of themselves and the grower feels confident that, having given attention to preparing the soil, planting, rowing and some cultivation, he can now take a rest, so far as that block is concerned.

In the meantime, what is going on in this plantation during this period of four to six years in which the trees are growing to maturity? We have seen that in the beginning, with free access of light and air the conditions more nearly approach those of the thornbush in the veld, with the important exception of unlimited food supply. Owing to the preparation of the soil and the seed the insect population of the plantation must come in from the outside and during the first year or two the parasites extract a heavy toll from them. As the trees become larger and the plantation passes from what we may call the crop condition into the forest condition, with its accompanying gloom and moisture, the parasites no longer follow the insects and they have a change to increase rapidly. As a result of this increase and subsequent crowding, aided by the above named atmospheric conditions, diseases appear amongst them and strive to maintain the balance which was lost by the presence of the parasites. At last another condition is reached where the total of deaths are from various causes practically equals that found in the veld.

But unfortunately this applies only to the exposed feeders and leaf eating insects. Those which are living in the wood or in the soil are much less subject to these various diseases, and again with the absence of parasites, have a chance to increase at a rapid rate. Dead or sickly trees, not being removed, form centres from which the neighbouring living timber is being infested, and form a constant danger. That this danger is not imaginary was brought home to the writer in a plantation near the Coast where three acres of promising young trees had been destroyed by a small wood borer, *Eunidia pusilla*, which had bred in a few isolated trees scattered through the block and which had been pointed out by him two years previously.

Thus during the time that the trees should receive most careful attention in the way of cultivation to destroy root feeding insects, and the removal of dead and sickly trees, they are being practically entirely neglected.

When the surviving trees become mature, say eight years old, the stripping and felling begins. These operations can be passed over as having no bearing on the insect problem. What interests us is the fate of the plantation after the harvest is completed. The brushwood is heaped over the stumps, (and when too far from the rail-head to make the removal of the wood profitable, the stems also) is left to dry, awaiting a favourable opportunity to be burned up when the barking of the entire block is completed. This may be several weeks or even months, depending on the size of the blocks being stripped and the weather conditions; in the majority of cases the burning is postponed until well into September or October. Now as a rule the trees which are being felled have been infested with bagworms the previous season, while many other leaf-eating insects are in the cocoon stage. This brushwood being left for a considerable length of time the bagworms reach maturity, mate, oviposit and the young are found hatching before the burning and we see the brushwood covered with the webb-

ing made by the young bagworms. These are picked up by the wind and distributed by the million to infest other plantations. The moths of other species have a chance to emerge and fly away into neighbouring blocks before the mass is set alight and the result is that the fire destroys — the empty bags and cocoons, plus any parasites which may be present, as these usually make their appearance long after the emergence of the moth. The burning also destroys all fungus spores and disease germs which, as shown were on the increase when the plantation was nearing maturity. The only beneficial effect, entomologically speaking, derived from the burning, is the baking of the soil and the charring of the stumps and even these advantages are less than would appear. The heat does not penetrate deeply enough to reach those insects which are living on the roots, killing only such as are near the surface, and the latter are just the ones which are more heavily parasitised as the Scolie does not go deep into the soil to hunt the cockchafer larvae And the fire destroys friend and foe alike.

The charring of the stumps will for a time effectively prevent their being used as breeding places for wood boring beetles. But it also prevents them from rotting away quickly, and before this process begins, cracks have generally appeared in the charred surface, in which the wood is exposed and by which the beetles may enter for oviposition. In the case of stumps rotting quickly, the beetles breeding therein would upon emergence not find trees in the new plantation of sufficient size to tempt them. But the charred stump remains longer and the beetles which, after a time start breeding therein find, when emerging, the new plantation well grown and containing several sick and dead trees which will attract them, and which, as shown above, act as centres of infestation for the healthy trees around them.

Size of the Blocks.

This ranges anywhere from ten to five hundred acres, two hundred acres would probably represent the average size. This large extent of the blocks is also detrimental, for the reason that the larger the block the smaller the percentage of the number of trees exposed to the light on the edges, the insects on these being more heavily parasitised. Secondly the smaller blocks are more easily inspected for diseased or dying trees and these, together with brushwood, resulting from eventual thinning out, can be easily removed to the outside and burned. Thirdly, the larger the block, the longer it takes to harvest and thus the longer the burning has to be postponed, which is undesirable, as shown.

Summing up, we find that from the view of the economic entomologist the present methods of wattle growing leave very much to be desired, in fact, the danger, nay the certainty of insect infestation is being entirely lost sight of, even in the most up to date methods. The one and only reference I have seen to the danger from insects is by the same grower in the article cited at the beginning of this paper, where he recommends scattering the several seeds in the hole so that insects coming along to eat it might leave some, so that at least one plant would come up in the place provided. Otherwise the insect-side of the wattle plantation is entirely ignored. What would one think of a commercial fruit grower of the present day who would lay out a new orchard and grow the trees without making provisions to facilitate the control of the insects which he knows are certain to come along, and who would simply be hoping and expecting that natural enemies would effectively control the pests? This is exactly the condition which we find in regard to the wattles to-day. The present day wattle plantation is, entomologically

speaking, an abomination; such improvements as are being advised are being prompted by commercial considerations while no provisions are made or precautions taken to facilitate the insect problem. In fact, present day wattle growing is a good example of intensive culture without the intensive cultivation which should accompany it and an attempt towards a satisfactory solution of the insect problem will have to go hand in hand with considerable changes in the present methods of wattle cultivation.

The Carabidae of Salisbury, Mashonaland.

By Rev. J. O'Neil, S.J., F.E.S.

In his "Descriptive Catalogue of the Carabidae of South Africa", published in 1896, Dr. Péringuey described or recorded 103 species of Carabidae from Salisbury. His three Supplements, which appeared in 1898, 1904 and 1908, added another 43 species to those known to occur in this locality, and Mr. C. N. Barker described seven more in the "Annals of the Durban Museum", issued 31st March of the present year (1919).

After collecting for over six years in and around Salisbury I am able to state that the total of 153 recorded species represents less than one half of those that have been found here. To my certain knowledge no fewer than 334 species of the Family occur in this neighbourhood, and all of these, with only about a dozen exceptions, I have taken here myself. They belong to 98 different genera, and to 30 of the 34 Tribes that have representatives in South Africa. A certain number I have been unable to identify from Péringuey's descriptions. These are probably undescribed species, which I intend to describe as soon as I am able to ascertain with reasonable certainty that they *are* new.

As many of our local species have not been recorded from Rhodesia, and among them are several very great rarities, a complete list of those that occur at Salisbury may be useful.

Tribe *Omophronini.*

The only member of this Tribe at Salisbury is the common and widely distributed *Omophron suturalis,* which is found here in numbers in sandy river-beds close to the water's edge. In Salisbury specimens the prothoracic anterior yellow margin is very narrow, and the sutural dark metallic green (rarely, light chocolate brown,) band of the elytra varies considerably in width and shape.

Tribe *Carabini.*

Two species — *Calosoma senegalense* and *C. planicolle* — both taken at light, the former rarely, the latter in some numbers. *C. senegalense* appears to have a wide range in S. Africa. I have specimens from Durban, Beira and Salisbury, and Péringuey records it from Damaraland. In Salisbury examples the shining brassy spots on the elytra are sometimes obsolete. One of my local specimens has a length of 30 mm.

C. planicolle appears to be distributed all over S. Rhodesia. I have taken it at Umtali, Salisbury, Gwelo, Umvuma and at the Empandeni Mission twenty miles south of Plumtree. The length of my specimens varies from 28 to 34 mm. On the Zanzibar mainland this species appears to be common, and examples that I have seen from there are distinguished by their large size, and by the intervals and outer margin of the elytra being dark metallic blue-green.

Tribe *Lachnophorini.*

Represented at Salisbury by the pretty *Lasiocera egregia,* Pér., which was discovered here many years ago by Dr. Guy Marshall and appears to be exceedingly scarce.

The allied *L. tessellata,* which I have taken in abundance near Plumtree on the *mopani* sand belt, and which is also found in numbers in the Matopo Hills, has not yet been recorded from Salisbury. It is frequently captured at light.

Tribe *Egini.*

The two curious ant-like S. African representatives of this Tribe — *Pseliphanax natalensis* and *Amoebaea mashuna* — both occur at Salisbury. I have taken the former here occasionally at grass roots in damp spots, and could not help noticing its striking resemblance to a small shining black ant. *A. mashuna* is extremely scarce here, but abundant in parts of Matabeleland, especially near Plumtree and in the Matopos, where it is to be seen in great numbers, running about swiftly in the company of *L. tessellata* on the wet sandy soil under the *mopani* trees.

Tribe *Hexagonini.*

Only one species of Hexagonia — *H. venusta,* Pér. — has, to my knowledge, been found at Salisbury, and it is very rare. Three others — *H. immaculata, umtalina*, and the narrow *angustula* — are taken in some numbers at Umtali.

Tribe *Odontocanthini.*

Of this interesting Tribe we have at Salisbury three species of Casnonia and three of Stenidia. Of the former, *C. dstincta,* Pér., is very abundant locally, and unlike its congeners, it is very often found in dry spots. It frequently flies to the light in summer months. *C. amoenula*, Pér., is gregarious and very local, occasionally taken in numbers in a bed of reeds. The pretty *C. suturalis,* Pér., which I have also received from Beira, is very rare in this locality, and my only Salisbury example is one that I found at a grass root near running water.

Of Stenidia, I once took here a large number of examples of the very pretty *S. jucunda,* Pér. They were hibernating in a reed-bed in June. I have captured a few specimens of this *Stenidia* at light in summer. *S. elegantula,* Pér., I have also taken in reeds and at light, and more rarely, at grass roots. *S. angusta,* Pér., appears to be scarce here, and I have only found one example. It is much commoner at Umtali, and I have received several specimens from that town.

Tribe *Galeritini.*

This Tribe is well represented here by six species of *Drypta,* one *Eunostus* and five of *Zuphium.*

Drypta distincta, dentata and *mashuna* I have taken not uncommonly in flood refuse. *D. melanarthra* and *D. ruficollis* are much scarcer here, and the small *D. brevis,* Pér., which occurs at Umtali also, is exceedingly rare in this neighbourhood.

Eunostus guienzii flies to light occasionally between December and March. *Zuphium caffrum,* Boh., and *Z. ustum,* Klug. are not very uncommon at Salisbury, and are taken under bark and, more frequently, at light. The latter I have also captured at light near Plumtree. Our three other local species of *Zuphium* — *bohemani, trimaculatum* and *debile* — are very scarce here and I have only managed to obtain a single specimen of each.

Galerita has not yet been recorded from Salisbury, though the large *G. angustipennis,* Gerst., which is quite distinct from *G. leptodera,* Chaud., is found both at Umtali and Beira.

Tribe *Helluonini.*

Six of these fine Carabidae are known to occur in this neighbourhood. Four of them, all of which I have taken here within recent years, belong to the genus *Macrochilus,* and are shapely and handsome beetles. The

largest of the four, *M. biplagiatus*, Boh., is sometimes found hibernating under bark or stones, but is more often taken at light in summer. Salisbury specimens vary in length from 13 to 16 mm., and one example that I captured at light last February has the head, prothorax, legs and the two patches on the elytra of an unusually light colour. Our three other local species appear to be very rare and I have only taken a single example of each, *M. hybridus* at light in February, *M. dorsalis* and an interesting variety of *M. varians* at grass roots in December. This last species has been found at Umtali, together with *M. viduatus*, *M. longicollis* and *M. spectandus*. The last two I have not yet seen.

Meladroma lugubris is not uncommon in the Plumtree district, and I have an example from near *Umvuma* and have seen a number of specimens that were taken at Hartley. It is a rare species at Salisbury, and I have only seen one locally taken specimen.

Triaenogenius vicinus and *T. corpulentus* are both common near Plumtree, where I have often found them running about on sandy paths at dusk. The latter has not, as far as I know, been recorded at Salisbury and the former is very rare here.

Tribe *Brachinini.*

The Brachinides are fairly well represented here by 14 species — two Pheropsophus, six Brachinus, one Styphromerus, one Mastax and four Crepidogaster. Of Pheropsophus we have *P. bohemani* var., *fraudiger* and *P. mashunus*, both, the latter especially, rare in this neighbourhood.

Our Brachini are.—*B. diffusus, B. caffer, B. solidus, B. mactus, B. placidus*, and an apparently undescribed species which is not uncommon at light. Of *B. mactus* I have only taken one example, in a marsh, and it differs from typical specimens in the absence of the sub-basal patch on the elytra and the reduction to a small dot of

the subapical patch. Our other species I have taken at light or in flood refuse.

Of *Styphromerus plausibilis* I have only one specimen, found under a stone. *Mastax ornatellus* is abundant in wet sand close to water.

We have here four species of Crepidogaster.—*C. insignis, C. scutellaris,* the recently described *C. marginicollis,* Brkr., and a fourth species which seems to be new. *C. scutellaris* is not uncommon under stones, but the other three are very rare here.

TRIBE *Lebiini.*

Of this large and extensive Tribe we have at Salisbury just sixty species representing twenty six genera. Nineteen of these have, to my knowledge, been recorded from Salisbury only, and three others seem to me to be new. The huge *Arsinoe grandis,* Pér., which in colour and general facies bears a strong resemblance to *Orthogonius dubius,* Brkr., probably requires the creation of a special genus for its reception. The very remarkable Eudema-like *Matabele miranda,* Pér. has been found in Matabeleland, at Bulawayo and the Victoria Falls, but I have not yet heard of its occurrence in Mashonaland.

Callida. Four species. *C. grata,* common under bark; *C. affinis* and *C. capensis* rare here; I have only taken two examples of each; *C. fasciata,* one example of this very pretty species at grass roots.

Lipostratia. Of this genus I have taken here, under bark, one specimen of a light rusty-red species that is probably undescribed. *L. picea* is common at Beira, but not found anywhere near Salisbury.

Metallica. *M. mashunensis,* Pér. I have taken one example of this species at light. In Matabeleland I have captured two other, much larger, species, the first near Plumtree, the second at Bulawayo. Both of these are probably undescribed.

Polyaulacus. Of this genus we have two species here — *P. brunneus,* Chd., which is very rare locally, though common at Beira, and *P. pallidus,* Pér., of which I have taken here three specimens under bark.

Cymindoidea. The large and handsome *C. marshalli,* Pér. is our only local species of this genus. I have found one example only, under a stone in December.

Hystrichopus. *H. angusticollis* is found here occasionally under dead leaves in damp spots. *H. recticollis* has also been recorded from Salisbury, but I have not yet come across it.

Plagyopyga. *P. cyclogona;* taken here occasionally at light.

Anarmosta. Of the rare *A. dispar,* which I believe has been recorded from Salisbury only. I have found three examples under bark.

Demetrias. *D. fragilis* is common here. *D. natalensis* is very much rarer locally, and I have only taken one example, at grass roots near running water.

Xenitenus. *X. dilucidus* is fairly common here under bark. I have also found in this neighbourhood a specimen of *X. tessellatus,* but slightly different from the typical form. *X. marshalli,* Brkr., described from a Salisbury specimen, is unknown to me.

Coptoptera. *C. indotata,* Pér., which I have not yet met with, is the only species of this genus recorded from Salisbury. *C. tenella,* Boh. will probably be found here, as I have received it from Marandellas, forty miles to the S.E. of this town.

Dromius. Only six species of this well-known genus have been recorded from South Africa, and all except one (*fusculus,*) of these are found at Salisbury. *D. flavosignatus* and *D. affinis* are common under dead leaves and decaying vegetation. *D. tibialis* is found with them, and is also taken in numbers among reeds and in gardens. *D. capensis* is to be seen occasionally, also in gardens; and of the pretty little *P. nanniscus,* Pér. I have taken two examples.

Klepterus. The two known S. African species of this genus — *K. consobrinus,* Pér. and *K. pallidicollis,* Pér. — both occur at Salisbury, and I have taken one or two examples of each at light and under bark.

Lionychus. The pretty little *L. basalis* is here, and is found occasionally, but not often, in wet sand close to the water's edge

Apristus. *A. latipennis* has been recorded from this locality. The only specimens I have seen are two that I found years ago, at Dunbrody, near Uitenhage, and one that I received from Mr. C. N. Barker, who took it at Malvern, Natal.

Phloeozetus. Five species of this genus are known to occur at Salisbury and we probably have more here. I have taken all of them under the bark of *Brachystegia randii. Ph. ambulans, Ph. mashunus* and *Ph. umbraculatus* are abundant; *Ph. praeustus* and *Ph. cribricollis* are very much rarer, and so far I have only found one example of each.

Lebia. Of this extensive genus ten species have been found in or near Salisbury. The list consists of *L. immaculata, L. nobilis, L. evicta, L. transvaalensis, L. phantasma, L. eximia,* and its variety *vaciva,* which was described by Péringuey as a distinct species, *L. natalensis, L. inedita, L. sperabilis* and the little *L. sebakuana,* Pér. Of these *L. eximia* and *L. natalensis* are common under bark, and I once found *L. sebakuana* in considerable numbers under dead leaves close to the river. Our other species are rare locally, and two of them — *L. inedita* and *L. sperabilis* — I have not yet seen.

Astata. *A. tetragamma* — the typical form with spotted elytra is found here occasionally under bark, and of *A. consors* I have taken a single example.

Lebistina. *L. sanguinea* is common in this neighbourhood, under the bark of *B. randii* and beneath stones.

Arsinoe. Of the nine described S. African species of this genus, (*A. trimaculata*, Motsch. is most probably a *Lobodontus*,) five occur at Salisbury, and a sixth, *A. notabilis*, Pér., is found at Umtali. *A. egregia* and *A. quadri-guttata* are abundant here under bark. The lately described *A. o'neili*, Brkr., is also found under bark, but is not common. In his description of this species, Mr. Barker stated that the stria of the elytra "are hardly perceptible". This was evidently a slip, for the elytra are rather deeply punctato-striate.

The very large and aberrant *A. grandis*, Pér., whose inclusion in this genus is open to considerable doubt, has been recorded from Salisbury only. I have found two examples of this remarkable Lebiid, both under the bark of *Brachystegia randii*, and both measuring 15 mm. long by 6½ wide. *A. fraterna*, described by Péringuey from Salisbury and Ovampoland, is unknown to me.

Lobodontus. Two species found locally: *L. gentilis*, which is common under bark, and *L. conjunctus*, Brkr., of which I have taken two specimens only.

Catascopus. Though Péringuey records only one species of this genus from S. Africa, I believe we have no fewer than three in the sub-continent. The one found at Salisbury and also at Umvuma, is very much larger than the *C. rufofemoratus* of Natal and the Transvaal, the colour of the upper-side is dark blue-green, not emerald green, and the longitudinal median groove of the prothorax is deeper and broader than that of the southern species. I have taken two examples at Salisbury: length 14 mm., width 5 mm. The third species, of which I have a single example from Beira, is similar to the last, but rather darker, and with the antennae and legs piceous black.

Thyreopterus. Represented at Salisbury by T. *flavosignatus,* of which I have managed to obtain only one specimen in six years.

Coptodera. Only one species, *C. notata,* occurs here. It is abundant under bark in the winter and spring months.

Pentagonica. Of these shapely little beetles we have two species here — *P. elegans.* Pér., and the small flavescent *P. o'neili,* Brkr. I once took three examples of the former and about two dozen of the latter under decaying vegetation near water.

Gen. ignot. In addition to the above I have taken here at light an example of a very pretty little Lebiid the genus of which is quite unknown to me and may prove to be new.

TRIBE *Tetragonoderini.*

Of this Tribe we have three species of *Tetragonoderus* at Salisbury. *T. scitulus* is found here occasionally; *unicolor,* Gemm. & Har. I have found once, and *T. immaculatus,* Laf. has been recorded from this locality (v. Péringuey, First Supplement to the Fam. Carabidae, pp. 339-40.) I have not yet met with this last here, but have received an example from Beira, taken by Sheppard in 1904. A variety of *Cyclosmus buqueti* with stramineous unmarked elytra appears to be common at Beira, but is not met with far from the coast.

TRIBE *Orthogonini.*

Orthogonius dubius, Brkr. is common here, and one is surprised that it was not described years ago. *O. brevicornis* and *O. capucinus* are also found here, but very seldom.

TRIBE *Graphipterini.*

The two genera comprising this Tribe are well represented at Salisbury; *Graphipterus* by thirteen species and *Piezia* by four — originally described as six spp. They

are to be seen in great abundance running about after rain in the sunshine in November and December. *G. mashunus*, *G. wahlbergi*, *G. lineolatus* and *G. nanniscus* are to be found almost throughout the summer.

Of Graphipterus thirteen species occur here, all except one (*G. egregius*) being exceedingly common. Seven of them—*G. limbatellus*, *G. bilineatus*, *G. tibialis*, *G. lincelus*, *G. velutinus*, *G. lateralis* and *G. fritschi* — are seen on the sand belt only, where they are, as a rule, plentiful after the early summer rains. *Antiokanus* is only found, sometimes in numbers, on small patches of black soil close to rivers or vleis. *G. wahlbergi* is very abundant on all soils and the colour of its pubescence is variable, examples found on the red soil being always reddish, and those taken on the granite and sand belt being yellowish or light ochreous.

Mashunus is one of the commonest of our local Graphipteri and is found everywhere throughout the summer. I have even taken specimens hibernating under stones in the depth of winter. In this species the difference in colour is even more marked than in the preceding. Examples found on the red soil always have the pubescence on head, prothorax and elytra of a deep red-ochre tint; in those seen on grey soil the pubescence is pale ochreous-yellow, while those found on the sand belt are remarkable for their uniformly larger size, the much greater width of the posterior black transverse band on the elytra, and the very light sandy colour of the pubescence. *G. darlingi*, Pér., which is found at Umtali, is merely a local form of *G. mashunus*, and is very like the variety found at Salisbury on the sand.

G. lineolatus and its var. *geminatus*, Pér. are abundant here, especially in or close to vleis; and the little *G. nanniscus*, which usually does not appear till the latter end of December, is common on the grey and black soils, but never seen on the sand. The large and handsome *G. egregius*, a very common beetle in Matabeleland, has been recorded from Salisbury, but I have never come

across it here. Like *G. mashunus* it shows great variability in the tint of the pubescence covering the upperside.

A certain amount of confusion exists regarding the species of Piezia found here, which are very numerous in individuals after the early summer rains. Some of them are found on the sand belt only, others on every kind of soil.

After a great deal of collecting and comparing I have come to the conclusion that *P. marshalli*, Pér. and *P. dissidens*, Pér. are merely varieties of *P. mashuna*, Pér. All three are found together, on all soils, and the differences between them are very superficial and do not warrant us in regarding them as distinct species. *P. virgulfera* and *P. licita* are seen on the sand belt only, where both are common. Though closely allied, they are, I think, distinct. *P. selousi* is also confined to the sand belt, on which it is common enough, and I believe it to be only a local race of *P. livingstoni*, Chd.

TRIBE *Anthiini*.

Of this very distinctive S. African Tribe we have 18 representatives at Salisbury, viz. *Atractonota mulsanti*, very common on the sand belt; the curious little *Netrodera formicaria*, of which I have only taken two examples, also on the sand; the mutilloid *Eccoptoptera cupricollis*, which is moderately common on all soils and is sometimes found hibernating under stones; eight species of Polyhirma, and seven of Anthia.

Polyhirma gracilis is rare here and I have only met with it twice in this neighbourhood. In Matabeleland it is an abundant species. *P. aenigma* is one of our commonest Polyhirmas, and is taken on all soils, being especially plentiful in vleis. Of the rare *P. perspicillaris*, Chd. I have received one example only, captured about twelve miles north west of Salisbury. *P. bilunata* and *P. ranzanii* are abundant on the sand belt, but not seen else-

where. *P. rutata* and *P. boucardi* are also taken here on the sand, but rarely. *P. semisuturata* is found everywhere and is our commonest local species. The allied *P. macilenta* is abundant in parts of Matabeleland, but does not occur here. *P. alveolata* and *P. plantei* I have received from Matabeleland, but they are not found any where near Salisbury. Of the very rare *P. suturella*, Chd. I have one example from Beira.

Our local Anthias are the common and well known species—*A. omoplata* and its var. *algoensis, A. massilicata, A. petersi*, Klug. (*burchelli*, Hope,) *A. thoracica, A, pachyoma* and *A. circumscripta*, all of which are common here.

A. cephalotes is found in the Victoria district and also near Umvuma, and I have received the var. *aequilatera* from the Mafungabusi, north of Gwelo. The varieties *ovampoa* and *desertorum* are common in the South of Matabeleland, and *A. cinctipennis* is found near Umvuma.

TRIBE *Morionini.*

Stereostoma corpulentum is taken here in some numbers at light. I have two species of Morio from Beira, but this genus has not been recorded from Mashonaland, as far as I know.

TRIBE *Scaritini.*

This Tribe is poorly represented at Salisbury, only four species having been recorded from this neighbourhood. Two of these—*Macrotelus persimilis* and *Taeniolobus nitidulis*—I have not yet seen. *Scarites praevius* is found occasionally in the rainy season, and *S. aestuans* was taken here last year.

TRIBE *Clivinini.*

Of this Tribe we have six representatives, two of which —*Clivina grandis* and *C. perplexa*—are locally abundant while *C. lacustris* is sometimes taken at light. *Bohemania gigantea* and *B. minor* are both rare here, and I have

secured only one specimen of each. Our solitary Dyschirius is *D. flavicornis*, Pér., and it is far from common.

Tribe *Siagonini.*

One Salisbury species only—*Siagona australis*, very rare here, though it and *S. caffra* are common at Beira.

Tribe *Harpalini.*

Of this great Tribe I know of 63 species that are found at or near Salisbury. Owing to the great similarity and plain pattern of many—especially of the Harpali and Hypolithi—they are liable to be overlooked, and it is probable that we have several more here as yet undiscovered.

Anisodactylus. Represented here by the following species — *A. sobrinus* (common,) *A. australis* (common,) *A. degressus* (occasional,) *A. inchoatus* (occasional.) *A. nitens* (rare.) and one more species, closely allied to *A. sobrinus*, which I am not able to identify.

Bradybaenus. The handsome *B. pseudoscalaris* has been found here once or twice.

Omostropus. I have found single examples here of *O. tersulus* and two other species that seem to be new.

Hypolithus. Of this difficult genus I know twenty species that are found here. Of these I have taken *H. escheri* (one example,) *H. tomentosus* (two ex.,) *H. porrectus* (one example,) *H. holosericeus* (abundant,) *H. imitativus* (common.) *N. audens* (rare,) *H. puncticollis* (one example,) *H. integer* (one example,) *H. interstitialis* (very common.) *H. melancholicus* (one example,) *H. difficilis* (common,) *H. orampoanus* (one example,) and five others that appear to be undescribed. In addition to the above, *H. cruentulus, H. turbatus* and *H. tetricus* have been described by *Péringuey* from this neighbourhood, but I have not yet come across any of them.

Siopelus. The three species — *S. insutus,* Pér., *S. limbatus,* Pér., and *S. venustulus,* Boh., — described in Péringuey's Catalogue, are all, the last especially, very common at Salisbury. They are found in winter under stones and dead leaves, and *S. insutus* and *S. venustulus* frequently fly to the light in summer.

Harpalus. Of this genus I have taken at Salisbury — *H. miles* and *H. dorsiger* (occasionally,) *H. spurius* (one example.) *H. nanus* (three examples,) *H. precarius* (one example,) *H. fusco-aeneus* (one example,) and four other species certainly not described in Péringuey's Catalogue.

Dyoriche. *D. figurata,* Boh., is common here, and abundant at Victoria and in Matabeleland. *D. seriata,* Kolbe, is often taken at light in summer. *D. picipes,* Klug., which I have taken in some numbers under stones near Victoria, and of which I have seen a long series from Beira, does not appear to occur in this neighbourhood.

Stenolophus. A genus poorly represented at Salisbury I know of only three species — *S. fallax, S. elegans* and *S. alacer* — that have been recorded from this locality and of these I have only found *S. elegans* here.

Acupalpus. I have captured nine species of these pretty little beetles at Salisbury, viz., *A. gracilis, A. capicola, A. pallidus, A. umbripennis, A. natalicus, A. decoratus,* and three others that seem to be undescribed. Most of them fly to light during the summer months. *A. capicola* is abundant here, and is found in great numbers hibernating under stones in the winter. It is very variable in pattern, and is, in my opinion, merely a variety of *A. gracilis* which is found with it. The prettily-marked *A. tessellatus,* Pér., is very common near Plumtree, but I have not heard of its occurrence in Mashonaland.

Amblystomus. Of these interesting little Harpalides we have no fewer than six species at Salisbury, where I have captured *A. intermedius, A. vittipennis, A blandus, A. ornatipennis* and two undescribed species, one of which I have also received from Beira. *A. ornatipennis* and *A. blandus* are common in summer, the latter abundant also in Matabeleland. *A. scitus*, Pér., is a very common species at Bulawayo and near Plumtree, but not found here.

Tribe *Panagaeini.*

We have five of these fine beetles at Salisbury — one Tefflus, three Eudema and the very curious *Trichisia rhodesiana*, Pér., described in 1908 from an Umtali specimen. Of this last I took one example at light in December 1914, and I have seen one that was captured at the Victoria Falls. *Tefflus delegorguei* is found here occasionally after the early summer rains running about after dark, and it sometimes enters houses, apparently attracted by the light. In the June of the present year I found a pair hibernating under a large stone on the top of a hill. *Eudema (Craspedophorus) zambezianum*, Pér., is a rare beetle in this locality. *E. sexmaculatum*, Pér I have found at different times in summer, five examples in all, on the top of a rocky hill close to Salisbury, and of *E. difficile,* Chd. I have taken two specimens here. As far as I am aware of, we have no local representative of the genus Microcosmus, though *M. aurantiacus* appears to be rather common at Beira, and has, I believe, been found at Umtali.

Tribe *Chlaenini.*

Salisbury is rich in these fine beetles, and among our local species are some of the rarest and most interesting of South African Carabidae.

Of the genus Chaenius no fewer than 29 species have been found in this locality, and I have myself taken all

but two of these within the last five years. The list is as follows: *Ch. bohemani var., fenestratus* (one example.) *Ch. ditulus* (one example, at light,) *Ch. fasciger* (two examples, at grass roots near water.) *Ch. perspicillaris* (occasionally at light in summer, or at grass roots in winter,) *Ch. cribellatus* (three examples found hibernating under stones,) *Ch. orampo* (two examples at light; this species is much commoner in parts of Matabeleland,) *Ch. bipustulatus* (occasionally,) *Ch. vitticollis, Ch. pulchellus* and its variety *fraternus* (all three common at light and under stones,) *Ch. verecundus* (rare, under stones in bed of river,) *Ch. cnonensis* (rare). These two last are much commoner at Umtali, where they have been found hibernating in numbers in the bed of a river, in company with *Ch. kirki, Ch. quadrisignatus* (one ex., close to the river after heavy rain,) *Ch. notabilis* (among reeds, rare,) *Ch. cribricollis* (common,) *Ch. cylindricollis* (common, under stones,) *Ch. angustatus* (common,) *Ch. laĉtus* (one example,) *Ch. comes* (one example,) *Ch. rhodesianus* (recorded from Salisbury, but the only example I have seen was taken at Umtali,) *Ch. caffer*. Boh., (one example of this handsome and very rare species, taken here at light. I have seen two other specimens, one from Beira, the other from the south of the Transvaal.) *Ch. Mashunus* (two examples, taken among reeds,) *Ch. validicornis* (common, often taken at light,) *Ch. consors* (I haven't yet seen this species,) *Ch. epigraphidus* (very rare, one example only,) *Ch. pronus* (one example,) and four other species which I believe to be undescribed. One of these is rather like *Ch. pronus,* but is considerably larger; two others belong to the *Ch. capicola-comes* group, and the fourth is a near ally of *Ch. vitticollis* and *pulchellus*, but quite different from either.

I have a single example of what I have identified as *Pleroticus lucidulus,* taken here among reeds. It is a pretty little beetle and seems to be very scarce.

The four curious termitophilous Chlaenides, *Parachlaenius singularis, P. violaceus, Rhopalomelus angusticollis* and *Procletodema parallelum,* are all found at Salisbury. The two species of Parachlaenius are rather rare here, though both come to light after the December rains. *R. angusticollis* is commoner and is often seen at light or running about after dark. Of the remarkable *Procletodema parallelum* an example flew into my room on the night of 13th October, 1917. The only other that I have seen was taken at one of the electric lights in town.

We have also at Salisbury five species of Callistomimus. *C. gratus* I have found in some numbers under decaying vegetation. *C. sex-pustulatus* is rarer, and I have only taken two specimens, under stones in summer. The pretty *C. elegans* is found occasionally, but rarely, running about on the sand belt after heavy rains in December. *C. caffer,* Boh., has also been found here, but is very rare in this neighbourhood. I have taken it in some numbers on damp sand near Plumtree. Our fifth local species, of which I have so far captured only one example, appears to be undescribed.

Tribe *Ooidini.*

These are rather uninteresting beetles, and most collectors appear to care little for them. At Salisbury we have eight—*Systolocranius discrepans,* of which I have one example only, and seven species of Oodes, two of which I am unable to identify. The other five are—*O. nanus, O. similatus, O. angolensis, O. deceptor* and *O. substriatus,* which are usually found near water at grass roots. The well known genus Melanodes does not seem to be represented here.

Tribe *Licinini.*

One species only—*Badister promontorii*—very rare here.

Tribe *Apotomini.*

The only Apotomus found at Salisbury is the well known *A. annulaticornis*, and it is seldom taken hereabouts.

Tribe *Masoreini.*

These are termitophilous beetles, two of which — *Aephnidius madagascariensis* and *Somoplatus substriatus* — are taken at Salisbury, usually at light.

Tribe *Pterostichini.*

Represented at Salisbury by the genera Abacetus, Drimostoma, Exocus and Pterostichus.

Of Abacetus at least eighteen species are found in this neighbourhood. Owing to their general similarity they are by no means easy to identify, and six of those I have found here are as yet undetermined. A certain amount of confusion exists with regard to some of the species, and a good Key to the genus is badly needed. Péringuey has described in the 1st and 2nd Supplements to his Catalogue, two very different species, to each of which he has given the same name — *A. diversus*. The first is found at Salisbury; the second seems to be common at Umtali and Beira. The species that I have taken here are — *A. emeritus*, *A. lucidulus*, *A. mashunus*, *A. auspicatus*, *A. optimus*, *A. alacer*. *A. diversus*. *A. cursor*, *A. discrepans*. *A. importunus*, *A. optatus*, and six others that I am unable to identify from Péringuey's descriptions. *A. obtusus* has also been recorded from Salisbury, but I have not yet seen it.

Of Drimostoma we have *D. longicornis* and a species not yet described. I have taken two examples of the former and one of the latter.

Exocus ferrugineus, which probably lives with termites, is taken here at light pretty often. I have also secured at light a single example each of two smaller beetles which I believe to belong to this genus.

Of Pterostichus I have only found one species here. It is closely allied to *P. natalensis,* Boh., and seems to be undescribed. I have taken four examples at Salisbury.

TRIBE *Platynini.*

Of this Tribe we have here eight species of Platynus and three of Euleptus. The Platyni that I have taken locally are — *P. gilvipes,* (abundant,) *P. crenato-striatus* (rare,) *P. oblongus* (1 example,) *P. vertagus* (rare,) *P. latiusculus* (common at grass roots close to water,) *P. alacer* (fairly common,) and an undescribed species near to *P. rufipes.* *P. fraternus,* Pér., described from a Salisbury specimen, is unknown to me.

Of Euleptus we have in this neighbourhood *E. elegans, E. intermedius* and *E. caffer.* The first is scarce here, the other two not uncommon.

TRIBE *Pogonini.*

The little *Extromus pusillus,* of which I have only one example, is the solitary member of this tribe recorded from Salisbury.

TRIBE *Trechini.*

Trechus vivax is our only species, and is by no means common in this vicinity.

TRIBE *Bembidiini.*

We have here the common *Bembidium variegatum* and an undescribed species of this genus, also a considerable number of Tachys, some of which seem to be new. Of the latter genus I have taken at Salisbury — *T. crassiusculus* (common,) *T. precarius, T. spurius, T. crassescens, T. humeralis. T. optimus* (common,) *T. humilis* (common,) *T. debilis, T. arrogans, T. pusillimus, T. minutissimus,* and five others that I am unable to identify. *T. secutorius,* Pér., described from Salisbury, I have not yet seen.

Addendum.

Since the above lines were written I have added five species to our local Carabidae, all of them captured on the summit of a hill about four miles from Salisbury, and all of considerable interest.

The first is a fine Macrochilus as large as *M. biplagiatus* and quite distinct from any known South African species of this genus.

The second and third are two Lebiidae, *Metallica formidulosa*, Pér., and *Astata cognata*, Pér., previously recorded from Natal only.

The other two are *Eudema impictum* and *Chlaenius mendax*.

The Collection of Aquatic Insect Larvae.

By S. G. Rich.

In this country the aquatic insects—Odonata, Ephemerida, Trichoptera, and the like—are known mainly in their adult forms. Except where a species is known also in other countries, the larva is almost always unknown, and the life history undescribed; in these insects as in other groups the new material available in adult forms alone, has sufficed to keep collectors fully occupied.

For example, of our S.A. Odonata, the only species whose larvae and life history are fully known are *Pantala flavescens*, a cosmopolitan form, and *Sympetrum foncolumbei*, found in Europe. Our *Anax imperator* is of a sub-species, the variety *mauricianus*, whose larva is not yet distinguished from that of the species in general. Several of our genera, as *Orthetrum*, *Trithemis*, *Lestes*, are known as larvae through other species of the genera found in more northern lands.

For identification of the aquatic larvae it is of course necessary to breed them through to the adult stage. In the Odonata and Ephemerida this does not mean the loss of the larva for description, as there is no pupation and the empty exuviated skin preserves the form of the larva almost perfectly. The colours are lost, but as the larvae are long-lived, there is plenty of chance to describe the living animal.

The more easily secured aquatic insect larvae are found in muddy and sandy parts of spruits. A most convenient outfit for collecting them is a garden rake and several small jars of water. Wherever the water is not swift, the mud from the edges and the bottom down to twenty inches deep can be raked ashore. The animals in it emerge from it and crawl to the water again: they are all slow enough so that nearly every one may be picked up. I prefer my fingers to any scoop or forceps for seizing them. In such places will be found larvae of *Odonata, Ephemerida,* and the worm-like larvae of several small midges (*Diptera*).

By holding a scoop-net in the stream just below a rocky rapid place, and having someone overturn the rocks lying loose in the stream's bed just above the net, a number of larvae of Tipulidae, etc., will be dislodged and will be swept into the net.

Mosquito-pools are worth prospecting, both in the water and in the mud forming their bottoms.

The breeding of the swift-water forms requires an aquarium which has a continuous supply of running water. Mosquito-netting spread over the top of the vessel will of course prevent the adults from disappearing when they emerge.

The forms inhabiting relatively motionless water may be kept alive in trays indoors, in which the water is renewed occasionally. They must, however, be fed To secure more natural conditions and permit of growth and metamorphosis under study, Needham has devised a simple aquatic cage. This is simply the frame of a box,

about the size of the large paraffin tin, and covered with wire netting. There is one side left without netting: this side is placed downwards. The cage is placed in a stream, in a still part, with a muddy bottom, and is sunk two or three inches into the mud. It protrudes above the surface, and also prevents the escape of the larva through the mud or water. The larva is in its natural habitat under the cage, but has in the cage-walls a convenient mode of egress from the water. A daily visit to see what is in the aerial part of the cage, and to take what has emerged, is all the care necessary.

Some of Needham's pupils add a door in the top of the cage. I do not find this necessary unless a number of larvae are to be reared in one cage. The cage can be lifted gently and a net slid underneath it at once to take any adult in the cage.

It is often not wise to kill, pin and set any adult thus bred, at once, as they are often immature in colour and soft when found. A day in a roomy bottle will not damage them: they may then be killed and set. In setting any adults with long bodies it is wise to insert through the frons a pin, cut off to a suitable length, which will run through head and thorax into the abdomen and hold together the body. Odonata, especially, often fall apart if not thus artificially made into "Vertebrates."

When several specimens of a larva are found together, as is often the case, some may well be preserved as larvae. It is useful to preserve as many instars as possible. My experience is that aquatic larvae do not preserve well by any dry method. The colours have, in my experience with these, kept best if the larvae are both killed and preserved in very weak formalin. A two per cent. solution of formalin is quite strong enough: I now have specimens which have kept in perfect condition since 1914 in formalin of half that strength. An important detail is to slit the larva along the abdomen as soon as it is dead.

so that the preservative may enter the body. A small ventral slit is sufficient.

Small flasks or chemists' bottles, holding one-fourth or one-half an ounce, are excellent for keeping this material. A thick plank, with holes drilled into which the bottles may fit, is a convenient holder for such a collection.

Much of what Mr. Hardenberg writes about the study of Lepidopterous larvae, and the interest and usefulness of collecting them, applies to the study of aquatic larvae. The comparative anatomy of such items as the curious grasping elongated labium of Anisopterous larvae, or the gills at the end of the abdomen in Zygopterous larvae, have proved interesting to workers elsewhere. There are in these larvae some remarkable instances of close and perfect adaptation to their mode of life. One of the Ephemerid larvae of the Nearctic region has a complete apparatus for catching by means of a net the small Crustacea on which it feeds. The Anisopteran dragonflies, inhabiting muddy bottoms, as larvae, have a gill-chamber that is not only a highly perfected machine for respiration, but that is completely protected from the ingress of harmful particles in the water.

The list might be much extended, but the mere fact of its being a field nearly wholly untouched in South Africa should serve to attract collectors to the aquatic larvae of insects.

Notes on the Charadriidae or Plover Family.

By AMBROSE A. LANE, Mooibank, Potchefstroom.

The plover tribe cannot fail to attract the interest of the sportsman and field naturalist, as a characteristic feature of similar localities in widely separated regions The peculiar flight and loud lamenting cries of the Lapwing are to be seen and heard in so many remote stretches of open plain, swamp, or estuary, both in the old world and in the new that the various closely allied species (usually formerly all included in the genus *Vanellus*) have become one of the most familiar features of wild life to even the casual observer.

The appearance and whistling note of the wary Oyster-catcher on the sandy margin of the sea-shore; or the comparative tameness of the pretty little Sand-plover, may not be so generally familiar. Here again the similarity of notes, movements, and habits of closely allied forms, extending along many thousands of miles of coast line appears to extend over the universe indefinitely, and amongst almost thirty species of the *Charadriidae* recorded in South Africa, several of the maritime species extend to the northern hemisphere Doubtless most of these are migratory, as most of this family appear to be inclined to migrate, especially those species which congregate into large flocks, after the breeding season. Others, like the Lapwings, which have developed into more characteristic local varieties, appear to be more or less resident, appearing in pairs during the nesting season, and at other times assembling in small flocks which, though of a roving disposition, probably do not go far unless driven by extreme conditions of climate or food supply. Amongst insect-eating birds the plovers found inland are undoubtedly of great utility to agriculture, and their usefulness in this respect alone should entitle them to protection by the

farmer. Fortunately for him, in this locality they are pretty well represented. The most familiar species is probably the Crowned Lapwing (*Stephanibux coronatus*) known locally as the "Kievietje", whose characteristic flight, and loud dolorous cries, are a common feature of the landscape in the neighbourhood of a dam, or piece of swampy ground. This is especially the case in summer time, when they are usually found in pairs. At other seasons they go about in small flocks.

This bird, which is about eleven and a half inches long, and has a wing span of about twenty-one inches, is slightly larger than its relative, the Blacksmith Plover (*Hoplopterus speciosus*). The latter may be distinguished at a distance by its more metallic note, and when seen closer it has a white forehead, black throat, and dark slate coloured legs and feet. The true "Kievietje" (Crowned Lapwing) has a white band encircling the crown of the head, from which it takes its name. The throat is white, and the legs and feet red. It is more numerous locally than the Blacksmith Plover, which is usually only seen here in pairs, during the summer months.

Some years back the pretty little Variegated Sandplover (*Charadrius varius*) was very common in this district, especially about "brak" ground, but during the last few years it has disappeared from many spots which it used regularly to frequent. The reclamation of the land, and draining of "brak" ground, appear to be forcing this handsome little plover out of existence as an inland resident. I found a nest with two eggs on 21st October, 1913, on a bare stretch of sand near a vlei. It was simply a hollow scraped in the sand, the eggs being difficult to locate as they lay in a depression below the surface level. The bird slipped off quickly upon being approached, and ran silently away, but not before she had most artfully covered the eggs with loose sand, so that one could at first see nothing but the bare level of the surrounding surface, but closer investigation de-

tected the tiny patch recently disturbed and in which they were buried. They were of a greenish-drab ground colour, thickly speckled all over with blackish dots or streaks. The length was 1.24 inches, and the diameter 0.88 inches.

The Thickknee (*Oedicnemus capensis*) is a resident and, judging from their flute-like calls frequently heard at night, are much more numerous than one might suppose, as they are comparatively seldom seen, concealing themselves by day in bush or thicket but becoming very active and clamorous after sundown. From what I have observed they have probably a wide range of diet, including mealies and grain, but any toll they may take in this way is more than counteracted by a considerable insect bill of fare, which they doubtless prefer.

The Black-winged Pracincole (*Glareola melanoptera*) known here as the "locust bird" occurs periodically in flocks. During the day it spends most of the time on the ground, and destroys large quantities of caterpillars and their larvae. After sundown they are to be seen actively hawking on the wing in wide circles, when their long wings, forked tails, general dark colour, and mode of flight, reminds one very much of petrels. Though an inch shorter in length than the "Kievietje" their span of wings in flight is about the same. They may be distinguished, by the general isabelline brown, or mouse coloured tint of the upper plumage; white throat and rump, and black wings. They usually appear irregularly in large flocks, which apparently quickly exhaust the food resourses of the locality, and move on in search of pastures new.

Two kinds of coursers are found on our veld, the most numerous being of a reddish hue above, probably *Cursorius rufus*, but the Two-banded Courser (*Rhinoptilus africanus*) is fairly plentiful, at all events during the summer. On 16th October, 1917, I found a single half hatched egg on a piece of bare shingly veld, where it might have been mistaken for one of the surrounding

stones, as there was no apparent attempt at making a nest. It was 1.85 inches long, 0.75 inches in diameter; it was thickly mottled with vandyke brown on a dark drab ground colour. One or two other species of plover occur here periodically but I have not yet been able to satisfactorily identify them.

The Birds of the Buffalo Basin, Cape Province. III.

By The Rev. Robert Godfrey.

The Black Tit — *Parus niger* Vieill — ranges throughout the mimosa country and along the edge of the forest, where its noisy and obtrusive habits force it upon our notice In small exploring parties it works its way among the mimosa, continually jerking out its rough cries and sometimes displaying effective work on the twigs with its powerful bill. The Kaffir name *isicukujeje* is an attempt to reproduce one of its cries. This species has also a song whose period has not, however, been worked out.

On 16th December, 1914, attracted by the rowdy calling of one of these birds, my wife and I watched one fly into a dead yellowwood. It was carrying food in its bill, and, without abating its noise, it flew to its nest-hole, a crack in the stem about twenty feet from the ground. Transferring its burden to its young, it flew off and soon returned in silence with another fat grub. It moved about for a little in the tree, and at last disappeared completely into the hole; on emerging it was carrying with it a dropping. All this was done in silence. Nine minutes later it cried in the tree, but, as it made no sign of returning to its nest, we left it. The nest itself was quite beyond our reach.

The Cape Penduline Tit — *Anthoscopus minutus* (Shaw and Nod.) — is known locally as the Snow-bird from its beautiful domed nest of wool or vegetable down. On 21st November, 1907, Mr. Matthews, of Woodstock, Alice, on whose farm this little bird is a well-known breeding-species, showed me a nest taken locally, and on 15 November 1910 at Fort Beaufort, Mr. Kenneth Anderson shewed me another taken in his neighbourhood.

Pym has obtained the nests from Queenstown and Stutterheim. These occurences are beyond our borders, but within our area it has been met with at Cambridge by Colonel Griffith who informed Mr. John Wood of the fact.

The Cape Long-Tailed Sugar-Bird — *Promerops cafer* (L) — reaches in the Buffalo Basin the Eastern limit of its range. It is one of our rarer species but has been seen by Pym on the Amatola mountains, and is represented in the local Museum by a male procured at Kei Road by Miss Hudson in 1904 (The allied Natal Sugar Bird — *P. gurneyi* Verr — does not occur nearer us than Elliotdale, whence, on 28 November, 1914, a specimen obtained by Rev. J. Henderson Soga in a fruit-net in his garden at Miller was forwarded for identification).

The Orange-Breasted Honeysucker — *Nectarinia violacea* (L) — also reaches in the Buffalo the Eastern outskirt of its distributional area, and has only once been obtained here. The specimen referred to, taken by Pym at Pirie in October, 1903, is now in the local Museum.

The Malachite Honeysucker — *N. famosa* (L) — is widely distributed, though not numerous, both above and below the forest-belt, being naturally more abundant in the neighbourhood of such favourite honey-bearing plants as the sugar-bushes and the Kaffir-boom (*Erythrina caffra*, Thunb.) In the spring months these birds mingle with their allies, as well as with the gorgeous black-headed oriole, the noisy parrots, the unobtusive bottle-nest weaver, the red-shouldered glossy-

starling, the black-collared barbet and other species, about the stately kaffirboom, and render the blazing red blossoms of the still leafless tree a scene of incessant activity. Though, as a rule, these honeysuckers perch on the flowers to suck the nectar, they occasionally extract the honey while hovering over a blossom. Nor do they despise such lowly flowers as the Red Dagga (*Leonotis*), beloved of their lesser double-collared cousin, and, like their confreres, they vary their honey-diet with insects captured in the air.

In full breeding-plumage, when clad in his metallic green livery and sporting two elongated and ornamental central tail-feathers, the male never fails to evoke admiration. Though around King William's Town odd males may appear in full summer garb before the close of July, the males in general do not deck themselves out in their beauty till the beginning of September. From this time onwards till the latter part of April, and even the beginning of May, they retain the brilliant robes of courtship.

With the assumption of the summer livery, the males undergo a marked change in their disposition and develop for the space of several months a fiery temperament. They pursue one another with headlong flight about the bushes to the accompaniment of shrill, racketty cry, and so eagerly do rival males engage in the chase that they lose at times the ordinary instinct of self-preservation. On 11 September, 1908, two males came dashing through a small window into one of the classrooms at Pirie, oblivious of all danger till rudely awakened from their paroxysm by the frantic efforts that were made by the children to capture them. One of the birds escaped; the other, after losing his tail-ornaments in the new fray with the children, was captured and brought to me in two portions. The live bird was set free, and the tail-feathers, which had constituted his pride, were sent across the sea for the admiration of Northern naturalists.

The period of song, though not fully observed, seems to coincide with the period of full nuptial-dress, lasting from about 19th September to May 6th. As the bird sings he very distinctly opens and closes his bill, as if he were chewing his notes. The call, resembling *seem* or *seep,* is a fairly loud, single note, which, being persistently repeated, challenges attention.

Pym records finding a nest locally in January, 1907, with two eggs.

Lesser Double-Collared Honeysucker — *Cinnyris chalybaeus* (L). — This, the most abundant and the best known of all our local honeysuckers, occurs wherever there are nectar-bearing flowers to supply its needs, and it is equally at home when taking toll from the ornamental shrubs and flowers around our houses, or from such common veld-plants as the Ded Dagga with whose foxy-red blossoms the breast of the male so beautifully harmonises, or from the flowering trees of the forest.

The male in nuptial dress is a gorgeous little fellow, quite conscious of his charms and ready to dispute his superiority with any rival. As individual males may be seen throughout the winter decked in all the glory of their metallic sheen, it is difficult to determine the exact period at which they don the eclipse plumage of the female. This irregularity regarding the date of doffing his nuptial robes leads to irregularity in the period of song, and full-dressed males sing throughout the winter months. It is very doubtful, indeed, if this species has any period of silence, though my note-book fails to record any instance of his singing in March or in April.

While giving vent to his loud, bold strains, the little songster fidgets about restlessly on his perch and bids defiance to all his kinsmen; two rivals, singing in each other's presence, will display in challenging mood the yellow pectoral tufts which normally are hidden out of sight, and they will then rise in the air for combat.

On 4 November, 1909, on the outskirts of the Pirie forest, one or two of these honeysuckers attracted atten-

tion by repeatedly visiting a lichen mass in a tree, and ere long one of them, approaching the spot with nesting material in its bill, revealed the meaning of the lichen mass. At a subsequent visit, five days later, no trace of the owners could be detected; and when eventually, on 16th December, a close scrutiny was made, the nest was found to contain a broken egg, which had no doubt led to the desertion of the nest. The nest was a compact ball of lichen, thickly lined with feathers and provided with a tiny entrance-hole.

Greater Double Collared Honey-sucker — *C. after* (L). — The resident and widespread species is much less abundant than its smaller relative. It is not so often seen in the neighbourhood of houses as that species, but this is probably entirely due to its comparative rarity, for at Somerville, Tsolo, where it is the common species of honeysucker, it is continually working about the flowers beside the house, and not infrequently flutters against my study window in its efforts to enter the house. As in the case of its allies, individual males are found in full nuptial dress even in midwinter, and while it is likely that the period of song corresponds with the period of nuptial dress, I have no record of the bird's singing in April and May.

While all nectar-bearing flowers attract the species, the Kaffir-boom, the Red Aloe, and the Blue Gum are favourites. On the Red Aloe the bird generally clings sideways in an erect attitude, but it may quite indifferently feed in an inverted position and work down the Aloe spike. In watching one of these honeysuckers at St. Mathew's, on 11 Dec., 1912, working on Indian-shot, I felt certain that in one case the bird pierced a hole through the base of the flower, instead of inserting its bill in the flower, to reach the nectar. Like its allies, this species feeds on insects also.

As they feed, they utter a loud harsh call *tjee* or *djoo* which, as they fly off with their whirring flight, they change to a hurried *kukukuk*.

The Black Honeysucker — *Ch. amethystina* (Shaw) — is a conspicuous and abundant species throughout our area. Like its allies, it feeds mainly on nectar; but not uncommonly it indulges in an insect-diet, darting out repeatedly from the shelter of a tree to catch its prey in the air.

This is an exceptionally noisy species. The male, when in hot pursuit of a rival of his mate, utters a shrill neigh or whinny, which is the most characteristic trait of the species, and which has its counterpart in the racketty cry of the Malachite Honeysucker. I have heard a bird attempt the whinny on July 27th, but the full whinny goes on from 7th August to March 21st, corresponding, that is, with the breeding season.

My notes on the song-period are very meagre and are doubtless incomplete. They give the singing period as June, August and September. In the case of this species, the female also has a song. On 17th August, 1918, I watched a female singing a low continued song from a bare twig, while the male was perched high above.

Nest-building begins in September, and the birds are engaged in home-duties till far on in April. On 28 September, 1908, at Pirie, Mr. John Ross found a nest slimly suspended from the lichen-covered branch of a tree. On October 2nd, when taken, the nest contained one egg. The nest was a thick loose mass of grasses, with a few broader blades, some leaves and glistening white vegetable down; in shape it was a loose bag, measuring 171 millimetres deep by 89 thick in external measurements. The upper margin of the entrance hole, which was a side opening 55 mm. high by 50 broad, was loosely constructed, but the small lower lip was distinctly formed. The lining consisted of a dense mass of feathers, belonging to the barnyard fowl, the guinea fowl and the common waxbill, with a quantity of vegetable down, some hair, a little wool and the fur of some wild animal. The egg, measuring 19 by 13 mm., is so thickly

covered with faint slaty-grey streaks as practically to hide the ground colour, and also has a very distinct zonal band of a darker shade forming a ring at the larger end.

Both at Pirie and at Somerville this species has nested close to the Mission house, hanging its nest in a tuft of dependent leaves in a gumtree at a height of from fifteen to twenty feet from the ground. The male maintains his interest in his mate throughout, whinnying after her as she passes to and fro, but does not seem to take any part in actually feeding the young.

Mouse-Coloured Honeysucker — *Ch. verreauxi* (A. Sm.) — Mr. Center, who has shewn me a specimen obtained in East London, informs me that this honeysucker is common in that neighbourhood. In the portion of our area best known to myself the bird occurs in scanty numbers, frequenting not only the forest itself but also the wooded banks of the streams that flow out of it. While preferring the opener parts of the forest or parts that are tending to degenerate into scrub, this species wanders also to suitable feeding places in the neighbourhood and used occasionally to visit the Kaffirbooms beside our cottage at Pirie. Being quite inconspicuously coloured it readily eludes the eye of an observer, but from 13 November to February 8—which is the period of song entered in my note-book—it cannot escape his ear. The song is a simple production of three notes *jip jojee*, uttered from a tree towering above the scrub or commanding an open space. The song may be preceded by a repetition of the alarm *tzin tzin*, or it may be interrupted to allow of the bird's going into a frenzy of excitement as it sometimes does in the presence of an intruder.

Sitting on a twig it will call and gesticulate wildly, uttering its alarm in a long-continued rattle and also resorting to another rattling cry which I cannot satisfactorily transcribe.

Olive Coloured Honeysucker — *Ch. olivacea* (A. Sm.) — has not come under my personal observation and does not seem to occur in the forest area. Both Center and

Wood have met with it in East London, and the former naturalist tells me that, though this species is inferior in numbers to the Mouse-coloured Honeysucker, it is nevertheless common enough.

Southern Short-Billed Honeysucker — *Anthreptes collaris* (Vieill). — In the forest at Pirie, as well as in the coast-scrub at East London, this is a common species; it does not, however, in my experience venture near houses. It is a restless and noisy bird, moving about in small parties in the very heart of the forest as well as on its edge.

Nesting begins towards the end of September. At East London, Mr. H. O. Parsons has found the nest with the first egg laid on 11th October, and noticed two other eggs laid on the 12th and the 13th respectively. Mr. Wood also reports seeing a pair on 14 October, 1911, building their nest on a bush overhanging a stream at the bottom of a deep kloof above the Nahoon Causeway. At Pirie a nest with three eggs was brought in on 6 December, 1911, and another with two fresh eggs on 29 December, 1910. On 7 January, 1910, Miss Carry Ross and I found a nest in the heart of the forest; it was conspicuously enough suspended in a rather open bush at a height of six feet from the ground, and resembled a tiny shoe hung up by the heel. The owners of the nest flitted excitedly about us, uttering a low alarm. Later in the day, while watchinig a spider working with a large cicada in its web, we saw one of those honeysuckers come three times to a tree a few yards from us and pluck off pieces of dead asparagus, collecting a number of pieces in its bill before it flew off, but we could not trace it to its nest. Mr. Center records seeing on 20 May, 1917, near the Blind River, two youngsters just out of the nest and remembers noticing one at midwinter some years previously.

The nest brought on 6 December, 1911, was an oval ball, formed externally of rough grass blades up to nine millimetres in breadth. The rough grass is partially bound together with exceedingly fine plant-stems, but not

so tightly as to prevent the nest retaining a loose appearance, and several of the broad grass-blades are left trailing in a way that makes the nest resemble a casual rubbish-heap. The rounded entrance is immediately under the pedicel, and is margined with the very finest vegetable material, but no special skill is displayed in the weaving of the lip-margin and a straggling blade of grass projecting over the entrance keeps up the general rubbish-heap appearance. The pericel itself is also of fine material, with a distinct flap falling down over the entrance. Whether this flap is actually intended to be loose and form a screen over the entrance, or whether its side attachments have been destroyed could hardly be determined after the handling it has received from the boys. The Interior is a cosy little cradle of the slender tops of *Galopina circacoides* with fine plant threads and a mass of feathers; some of the feathers—up to 86 mm. long—are very large in proportion to the size of the nest.

Most of our honeysuckers lay two eggs only, but the present species sometimes lays three. The eggs, 16 mm. by 11, are creamy-white in ground colour, but the markings vary greatly both in extent and in intensity; in some eggs, they form at the larger end a broad blotchy band of brown with underlying violet markings, and elsewhere on the shell much more sparing streaks and blotches of brown; in other eggs the indefinite markings of brownish-grey are so thickly set, with or without a clearly-defined zonal band of a darker shade, as well-nigh to obliterate the ground-colour.

Corrections and Additions to Previous Lists of Birds of the South-West Protectorate.

By C. G. Finch-Davies, Lt. 1st. S.A.M.R., M.B.O.U.

In the first number of the Journal and in the 2nd Bulletin, I published lists of birds collected in the Okanjande, Outjo, and Tsumeb districts of the S.W. Protectorate and a portion of Ovamboland. After the Ovamboland expedition my regiment was transferred to Windhuk, and I was stationed there from March 1917 until December 1918.

In the following notes I wish to make a few corrections and remarks on some of the species mentioned in my previous papers and also to add notes on species collected in the Windhuk district and not hitherto noticed.

The Windhuk district is for the most part considerably higher and more mountainous than any of the districts I had previously been stationed in and consequently, some species are found there which are not seen elsewhere Windhuk itself has an altitude of 6,400 odd feet.

Anas punctata — Hottentot Teal. A few of these teal have been shot time after time on the dams in the Windhuk district.

Dendrocygna viduata—White-faced Duck. A flock was met with, and two or three specimens shot, in the winter of 1917.

Casarca cana — South African Sheldrake. A single female was shot on one of the dams in the districts, by a friend who sent the bird to me for identification.

Otis ludwigi — Ludwig's Bustard. This species is fairly common in all the open country round Windhuk, where I have never met with the Stanley Bustard. All the large Bustards or Paauw are now Royal Game in the S.W. Protectorate and protected at all times of the year.

Pterocles bicinctus — Double-Banded Sandgrouse. I have on several occasions met with this species in the

Windhuk district, usually in pairs and small flocks amongst scattered thorn bush.

Vinago nudirostris — Bald-Fronted Green Pigeon. In my previous notes on the birds of Outjo and Tsumeb, I recorded the Green Pigeons seen by me, as belonging to this species. I did not, however, secure a specimen for identification and these birds may have been *Vinago Schalowi*, which has also been recorded from Damaraland. The only green pigeon I have shot, was a single specimen of *Vinago Nudirostris* at Otavifontein.

Francolinus gariepensis pallidior — Erickson's Francolin. *Francolinus vulgaris pallidior* — Gunning and Haagner. Check-list, p. 93. I have discussed the question of the correct names of the S. African Francolins. *F. gariepensis, F. jugularis, F. Shelleyi,* and *F. pallidior,* with Mr. W. L. Sclater of the British Museum who agrees with me that all these may be considered as geographical forms of one species, i.e., *F. Gariepensis,* and should in future be known by the following names:

Francolinus gariepensis gariepensis.

Francolinus gariepensis jugularis.

Francolinus gariepensis shelleyi.

Francolinus gariepensis pallidior.

The second named does not occur in South Africa as far as is at present known, but specimens from Tsumeb were considered by Mr. Sclater as being intermediate between *F. g. pallidor* and *F. g. jugularis,* so that the latter, which occurs in Angola, may also be found to occur in the north of Ovamboland. It may be known by the large patch of black and white feathers on the upper breast.

Coturnix delagorguei — Harlequin Quail. I have shot a good number of these quail in the grassy valleys near Windhuk. A number appear to spend the whole year in this locality, as I have shot them in midwinter (June and July).

Otogyps auricularis — Black Vulture. As recorded in my previous papers I found this Vulture rather scarce in the north, but while shooting on a farm about 13 miles

from Windhuk, I came across thirty or more of these birds feeding on a dead horse, in company with one or two Kolbes Vultures, and shot a fine adult.

Gyps kolbei — Kolbe's Vulture. This vulture appears to be rare in the S.W. Pretectorate. I only met with it on the occasion mentioned above, when I saw two or three, and shot one specimen for indentification.

Accipiter minullus tropicalis — Pale Little Sparrow-Hawk. I never met with this little hawk myself, but Major Thompson of the S.A.M.C. showed me an adult female which he had shot at Grootfontein, where he says they are not uncommon. Mr. Claude Grant of the British Museum, when writing recently of this species, says that he fails to see how *A. m. tropicalis* can be distinguished from the typical *A. m. minullus*. Te me there seems to be a vast difference between the distinctly *grey* upper surface of the former and the *black* colouring of this part in the typical race.

Circaetus pectoralis — Black-Breasted Harrier Eagle. This species appears to be rather rare, — I did not meet with it myself, but saw the skin of a fine adult female in the possession of a German at Windhuk, which he had shot near the town. There was also a nestling of this species in the small "Zoo" at Windhuk, taken from a nest in the district.

Aquila verreauxi — Black Eagle. This magnificent eagle has not been recorded before from the South West Protectorate. I was fortunate in being able to see a good deal of it in the Windhuk district, and also in finding a nest and taking the eggs, which are now in the Transvaal Museum at Pretoria. The nest was situated on a small ledge on the sheer face of a Krantz; but sufficiently near the top to allow one to climb down to it without much trouble. I found the nest some time before the eggs were laid, and kept a watch on it. It had been occupied the previous year and a young bird taken from it, which I saw in the possession of a German farmer. The birds started to renovate the nest some two months before the

eggs were laid, and the final lining was put in quite a month before the first egg appeared. The nest itself was built of dead sticks, the lining consisting of the leaves of a bush which grew plentifully on the surrounding hills. On visiting the nest on the 5th May, 1918, I flushed the male bird from the nest and found that two eggs had been laid. One pure white, the other of a white ground colour, covered at the *smaller* end with a cap of dark-red-brown (dry blood colour) blotches and spots; measurements 79·9 x 60·9 mm. On this occasion I stayed near the nest for some time and watched the parent birds. The male bird was comparatively fearless and often came back, flying past within range, but the female was very wild, and although circling round about, and not going far away, she never came within even long range of the nest. I know no prettier sight than to watch the flight and actions of this fine eagle. The jet-black plumage contrasts most beautifully with the snow white rump and inner scapulars, and every motion in flight is peculiarly graceful and at the same time powerful. — Now with motionless wings they sweep round in wide circles, getting higher and higher until they are mere specks in the sky, then all of a sudden the wings will be almost closed and the bird dives with one superb stoop almost to the ground; as it nears the ground the wings are opened and with a graceful curve it shoots upwards almost to the same elevation from which it fell, — a grand sight. Sometimes a pair may be seen playing in the air, and it is very pretty to see them making playful stoops at one another, the bird stooped at, turning on its back in the air, and with upturned talons pretending to ward off the feint-attack. The Windhuk district is well-suited to the habits of this species; the mountains are the home of Klipspringers and swarms of dassies which form their principal prey. I also found a freshly killed guineafowl lying in the nest before the eggs were laid. Although I saw two eggs in the nest, it appears that only one young bird is reared, as I have

never heard of more than one young bird having been found in a nest. The legs and talons of this eagle are remarkably powerful. One day the young bird mentioned above, when fully fledged, seized two small Angora Goat kids that came too near his perch — One in each foot — and would undoubtedly have killed then both if the farmer had not come to their assistance just in time I fear that this magnificent eagle is doomed to extinction in South Africa unless something is done to prevent it. Certainly they do occasionally kill a lamb or kid, and for this reason are usually poisoned or shot on sight, but it seems a great pity that this should be so, as the harm done is very small and is amply compensated for by the sight of such grand birds in the mountainous scenery they frequent and adorn. Their principal prey is the Rock-dassie; besides this they prey occasionally on young Klipspringers and game birds.

Formerly this species was only known to occur in the mountainous districts of southern South Africa and Abyssinia, and this huge break in its distribution was a puzzle to naturalists. More recently it has been recorded from C. Africa, Rhodesia and now in S. West Africa, and I think that it will eventually be found to occur right through the Ethiopian Region in the mountainous parts where conditions and food are favourable.

Unfortunately even now we know very little of the distribution of the larger birds of prey, as travelling collectors usually confine themselves to securing the smaller species of birds, being unable to carry large specimens.

Buteo augur — Augur Buzzard. I found the Augur Buzzard in the mountainous parts of the Windhuk district but it was not plentiful. In flight, cry and general habits, it appears to exactly resemble the Jackal Buzzard and I should not be surprised if some day ornithologists will consider it as only a geographical race of that species. I never met with the entirely black form of this bird, all the adults I saw being white breasted. I was lucky

enough to find a nest of this species on the 6th June, 1918, built in the fork of a tree standing on a very steep hillside. It was built of sticks, lined with grass and a few green leaves, and contained two eggs which were very "hard set"; unfortunately I broke one in trying to extract the embryo, while the other one is now in the Transvaal Museum at Pretoria. As the egg of this species has not been described so far as I know, I will give a description of the one egg in the Transvaal Museum:—

Shape — a rounded oval, slightly broader at one end.

Colour — white, strongly marked with red brown blotches, chiefly at the blunt end — only a few small spots elsewhere.

Measurements — 63 : 5 x 53 m.m.

Falco minor — South African Peregrine Falcon. Although I had on several occasions seen falcons which I thought were of this species, I have never been able to identify them satisfactorily. However a brother officer, while shooting rock pigeons at Windhuk, which came to the horse-lines to feed on spilt grain, made a very lucky "right and left", securing a fine male Peregrine and also the pigeon it was pursuing. Subsequently while out shooting myself, I was passing a ploughed field near a farm, and hearing a great commotion amongst a lot of doves that were feeding on the land, I looked up and saw a peregrine make a dash at one of them, but missing its aim passed so close over my head that identification was easy. The male bird mentioned above was somewhat different in the colouring of the underparts to any I had previously seen. The whole upper breast was a rich rufous buff without a sign of the spots usually present. The sides and thigh coverts were grey, barred as usual with black.

Falco ruficollis — Red-Necked Falcon. I have only twice met with this beautiful falcon, on both occasions in the Windhuk district. The first time I was shooting guinea fowl along one of the dry river beds which are

found throughout the country, when one of these falcons dashed out of a large Camel-thorn tree, and I unfortunately missed it with both barrels. However on a subsequent occasion, I came across a pair in some open country on another farm. They were rather wild, but I succeeded in shooting the male bird, a beautiful example in perfect plumage. The crop contained the remains of a bird.

Asio leucotis granti — Southern White-Faced Owl.

This little owl is not uncommon in the Windhuk district; I have often come across it amongst the thick thorn bush along the river beds. Judging by the contents of the crops of those I shot, its prey consists principally of insects, beetles of various kinds, grasshoppers and locusts, — also mice.

Clamator cafer — Striped-Breasted Cuckoo. I saw a few of these Cuckoos amongst the large Mimosa trees along the river banks; they are by no means common.

Irrisor erythrorynchus — Long-Tailed Wood Hoopoe. In my list of birds from Okanjande I recorded a Wood-hoopoe collected there by mistake as *Irrisor damarensis*. I never met with the latter subspecies at that place. although I subsequently discovered it at Tsumeb and later at Windhuk. I sent my Okanjande specimen to Mr. Roberts of the Transvaal Museum, who made the following remarks on the bird: "*Irrisor erythrorhynchus* (*angolensis*, according to Claude Grant's description, agreeing absolutely with Eastern Transvaal specimens)."

Riparia fuligula — Rock Martin. In my Okanjande list I recorded the birds collected there under the name of *Riparia fuligula anderssoni*. I am inclined to think that this subspecies has been founded on insufficient grounds. The dry air and bright sunlight in S.W. Africa has a strong tendency to bleach the feathers of birds, especially those specimens that are much exposed to it. Freshly moulted specimens of Rock-martins collected at Windhuk sent to Mr. Roberts of the Transvaal Museum were declared by him as indistinguishable from the typical race, I believe that had I collected these same

specimens after the feathers had had time to become bleached, they would have been identified as *Riparia Fuligula damarensis*, which is merely a pale form of *Riparia fuligula fuligula*.

Bradornis infuscatus — Brown Flycatcher. This large species is fairly common throughout the more open parts of the Windhuk district; it is generally seen in pairs, seated on the tops of bushes, and in general habits, resembles a chat rather than a flycatcher.

Muscicapa grisola — Spotted Flycatcher. This European species was fairly numerous at Windhuk during the summer months.

Batis pririt — Pririt Flycatcher. Led astray by an error in Sclater's Key to the species of *Batis* I recorded *B. molitor* in previous lists. I now find that all the Flycatchers of this group I have collected should be referred to *B. pririt*, I have not met with *B. molitor*, Sclater states that *molitor* may be distinguished from *pririt* by the webs of the outer tail feathers being white in the former and black in the latter; this is a mistake as these feathers have the outer web white in both species.

Tchitrea plumbeiceps — Lead-Headed Paradise Flycatcher. In my Okanjande notes I recorded the species collected there as *Tchitrea perspicilata*: this was a mistake, the only species I met with in S. W. Africa is *Tchitrea plumbeiceps*.

Pelicinius zeylonus — Bakbakiri Bush Shrike. I was rather surprised to find this well-known bird amongst some of the mountain kloofs in the Windhuk district, where it was however by no means common.

I might state here, with all due respect to those naturalists who insist so strictly on the rules of priority in scientific nomenclature, that it seems utterly absurd to retain the name of *zeylonus* for a bird which is strictly South African, never has been and never will be found in Ceylon.

Lanius luebberti — Reichenow (Vögel Afrikas II. P. 619.) This species was described by Reichenow from

specimens collected at Brakwater, Damaraland, which is near Windhuk. This so called species is nothing more than an immature stage of plumage of *Lanius minor*. I have shot several specimens in the Windhuk district which show the transition by moult from the *L. luebberti* plumage to that of *L. minor*. These specimens can be seen at the Transvaal Museum, Pretoria. As far as I could judge these immature birds arrive before the fully plumaged adult. *L. minor* is fairly common at Windhuk during the Summer months.

Ploceus velatus — Masked Weaver. I found a colony of these Weavers building their nests amongst the reeds growing in ponds in the public gardens in the town of Windhuk. This is the only place I have noticed them.

Vidua serena — Pin-Tailed Widow-Bird. I met with a few of these birds on one of the farms in the Windhuk district, but it appears to be scarce.

Serinus marshalli — Golden Seedeater This is rather a common Seedeater in the Windhuk district. I also noticed a few in the Okanjande district.

Fringillaria tahapisi — Rock Bunting. I noticed a few of these buntings on the rocky hills round about Windhuk.

Fringillaria capensis media — Lesser Cape Bunting. Rather common in all the mountainous parts of the Windhuk district.

Anthus rufulus cinnamomeus — Tawny Pipit. Major Thompson, S.A.M.C. collected two specimens of this pipit between Tsumeb and Ondongo, near the Etosha pan. I saw numerous pipits in the same locality but I did not collect any.

Certhilauda albofasciata arenaria — Namaqua Long-Billed Lark. I found this lark not uncommon in some of the more open country in the Windhuk district, frequenting stoney and sandy flats, generally in small family parties.

Pyrrhulauda verticalis — Grey-Backed Lark. Exceedingly common on the open flats in the Windhuk district,

often going about in large flocks during the winter months.

Eremomela damarensis — Damara Bush-Warbler. Fairly common amongst the thorn bush round Windhuk, always seen in pairs.

Saxicola monticola — Mountain Chat. Very common throughout the more mountainous parts of the Windhuk district, especially round farms and about the town of Windhuk. Much has already been written on the puzzling plumages of this species and no very definite conclusion has even now been reached, the most favoured theory and that adopted by Sclater when he wrote on this species in his "Fauna of South African Birds, Vol. II.", was that propounded by Messrs Butler, Fielden and Reid, viz., that the males of this species passed through a more or less regular series of plumages from black to grey. I however doubted this theory and wrote an article in the Journal S.A.O.U. in which I suggested that there were two adult forms of plumage in the male, one black — with or without the crown grey — the other grey, and that all the intermediate forms were the result of interbreeding. My observations of this species in the Windhuk district have still further confirmed me in the belief that my theory is correct. In the Windhuk district where, as I have already stated, this species is very common, and where I must have seen hundreds, the black form occurs for the most part, and all the time I was there I only saw and collected a single grey specimen, which I believe to have been a migrant. Now surely if this species changed from black to grey, I would have found a good number of both the *grey* and also *intermediate* forms, yet I found only *one* grey bird and *no* intermediate forms. I paid particular attention to this species and collected a good number of specimens during the two years I was at Windhuk. I did not meet with the form with the *white* or *creamy white* crown, which Sharpe considered might be named *leucomeloena* I however collected some with the crown very pale grey, almost white.

Notes on the Fauna of St. Croix Island.

By John Hewitt.

During the pioneer trip to S. Africa in the year 1488, Bartholomew Dias rested his crew on a small rocky island in Algoa Bay, and being favourably impressed, erected thereon a cross, according to a custom of Portuguese explorers. Thus it became known to seamen as the island of the Cross, Santa Cruz, or St. Croix Island. To day, the historical pilgrim may search in vain for any trace of the original cross, but his labours will be amply rewarded by the unique exhibition of animated nature: landing at St. Croix he will enter a new world.

An opportunity of visiting this little known island was recently afforded me through the kindness of Mr. Holford Walker of Pt. Elizabeth. My host, and his son Edward were primarily inspired by a zeal for fishing: my own interests were more general, embracing the whole fauna. Travelling in a motor boat, comfortable enough but tainted with the malodorous paraphernalia of professional fishermen as well as nauseous gases from the engine. the writer soon became quite *hors de combat*: the numerous sea-birds, and the hauls of large Ketunkel (presumably Thynnus pelamys) causing considerable excitement amongst the crew, had perforce to be disregarded, and even the distant view of the rugged rocks of St. Croix was quite repellent.

At first sight, it suggests the peak of a submerged mountain, the rocks rising to a height of 195 feet and sloping rapidly to the sea, with no sandy shore or gravelly beach. St. Croix is an isolated mass of Table Mountain sandstone, and from its hard white rocks, abounding in quartz, great angular blocks have split off, to be strewn in endless confusion throughout the whole area.

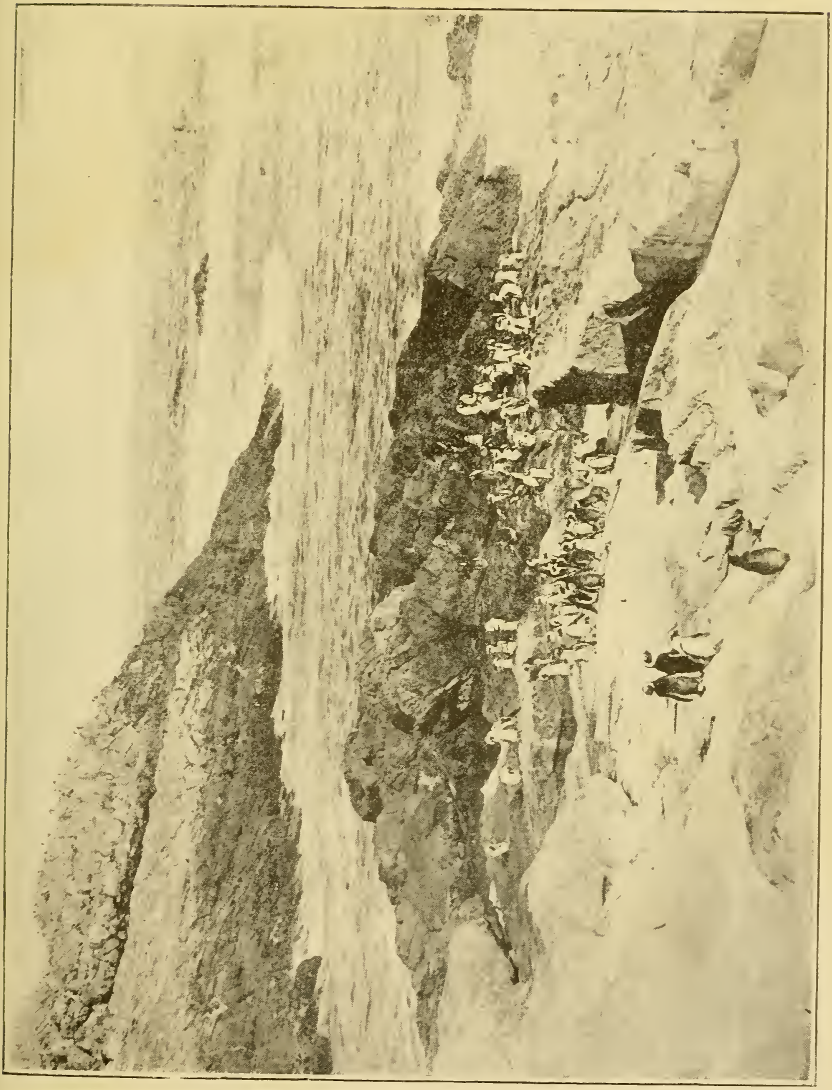


Photo by J. Hewitt.

Penguins on St. Croix Island. [White breasted Cormorants on distant rocks.]

There is good reason for suspecting that at no very distant period, geologically speaking, the island was completely submerged. In the neighbourhood of Redhouse near Port Elizabeth, and at various localities in the Alexandria district, there may be found deposits of marine shells in fossilised condition at high elevations. These shells must have been laid down under marine or estuarine conditions, in which case the land surfaces in this part of S. Africa have been raised at least a thousand feet since mio-pliocene times. Even within the period of penguin occupation, great changes of this nature can be traced; in his account of penguins on the Guano islands off the West Coast of Cape Colony, Mr. Hammond Tooke remarks:—There are now isolated mounds of guano on rocks on the mainland, shewing how the sea has receded from the land in comparatively recent times, guano being deposited only on islands. There is possibly direct evidence of former submarine conditions on St. Croix island, for certain calcareous incrustations found between the hard quartzite rocks at various elevations greatly resemble material formed under the sea by red algae and other marine organisms.

Under these circumstances, an island so recently formed is not likely to have any relics of the ancient terrestrial fauna or flora of Africa. For the most part, its population is a mere fragment of the mainland fauna, brought probably by casual agencies such as floating logs, or in some cases by winds. Actually, it is very small in number of species but rich in individuals.

The flora of St. Croix is completely devoid of trees or bushes, and I saw neither grasses nor sedges. The only plant that thrives abundantly is a white-flowered Mesembryanthemum — *M. angulatum*, according to Dr. Schönland who tells me that the species occurs also on Bird Island as well as on the mainland. It grows amongst the rocks throughout the island. There is no soil as ordinarily understood: between the rocks is a little sand more or less mixed with guano.

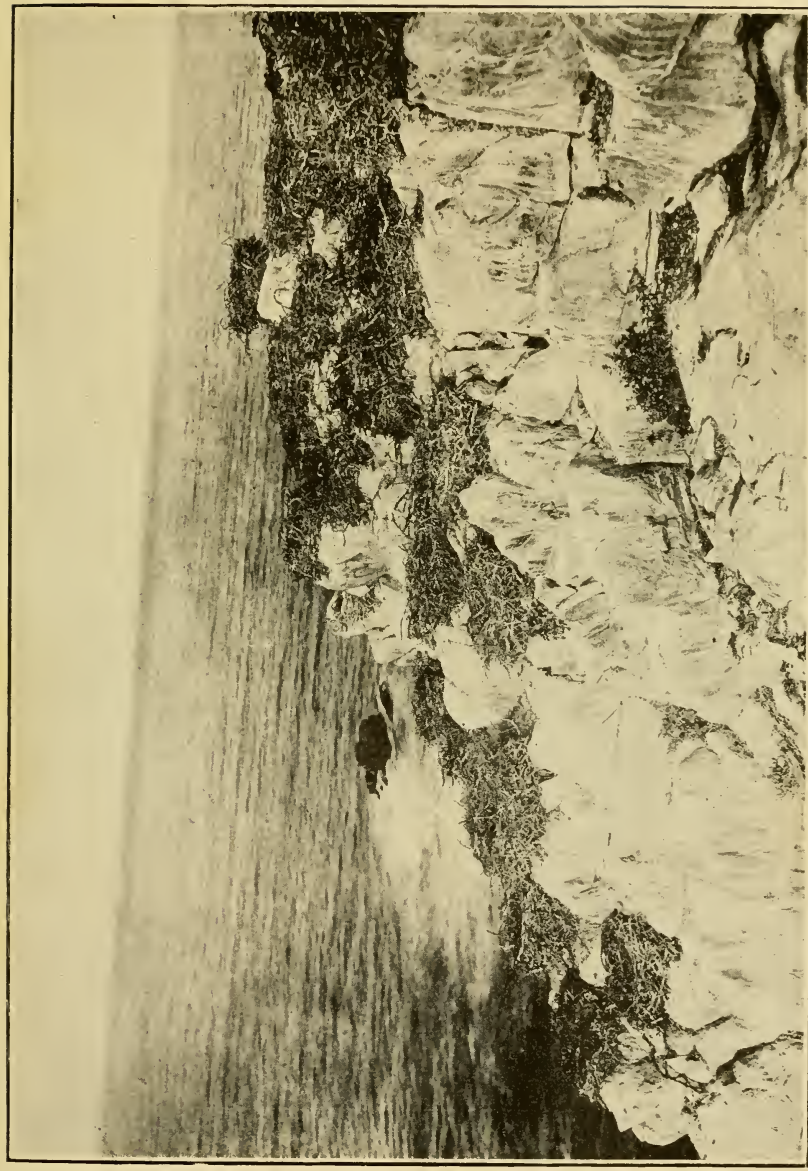
The Cape Penguin.

We were met at the landing place by a flock of penguins, most of which betook themselves in silence to the sea, on our approach. Although somewhat prepared for adventures with penguins, we hardly expected to find the island so completely monopolised by these fascinating birds. As we climbed and stumbled over the maze of rocks, nesting penguins greeted us from every sheltered nook, sometimes at every step in our advance. These rocks, traversed by countless generations of penguins, proved very slippery, and, also uncommonly hard—as witness our bruised limbs: to add to the difficulties, nesting penguins were no respectors of persons, biting savagely at all intruders. Thus we had to walk very circumspectly.

I regret that more time could not be devoted simply to the study of penguin behaviour, especially as it now appears that the various published accounts of Cape Penguins are very incomplete.

At the time of our visit, (Easter 1919), the majority of the birds were nesting. Others occupied themselves by inquisitively tramping the island, occasionally going down to sea on a fishing excursion. At several flat landing places, groups of penguins could be seen at any time during the day: here they basked in the sunshine, content to do nothing but peck and preen their verminous plumage. These landing places seemed to be permanently occupied at any rate up to 10 or 11 p.m., at which late hour though engrossed in fishing, we could not fail to notice the silent group of birds on the adjacent landing place.

As evening came on, penguin activities waxed in strength. The travellers waddled about in small flocks, for the most part quietly. On the other hand, the vocalists commencing in a leisurely way, poured forth their sonorous notes like the brayings of a donkey, but reduced in intensity, and as the concert increased, all other sounds



Nests of white-breasted Cormorants on St. Croix Island. *Photo by J. Hewitt.*

were drowned in the deafening roar of the undisciplined band. I believe that a menagerie composed of agitated donkeys, cattle and pigs in the proper proportions, would produce a somewhat similar result. Each bray issued forth in three or four lusty efforts of expiration, with the final trump specially loud and prolonged: then came the undignified collapse into a long shrill squeal, the inspiration. When braying, they directed their heads upwards to the skies, with due solemnity.

The choir was situated at some distance from our camp, amongst nesting birds high up on the hillside. I believe that nesting birds did not actually participate therein. Though no actual proof was obtained, I suspect that the vocalists were mostly, if not entirely, adult males.

The performance involves a certain amount of fatigue and perhaps for this reason there are no matinees. During daytime, the bird may often be seen in the act of yawning: with head upraised, he deliberately opens wide his mouth and takes in air.

Nevertheless, there is a good deal of noise and squabbling in a penguin camp during daytime. Where sitting birds are numerous, the whole population is in a state of tension, ready to fight with or without due provocation: they bite each other mercilessly, the victor often pursuing his vanquished foe for considerable distances. They have a characteristic bark when alarmed at close quarters, something like that of baboons.

In their choice of a nesting site, penguins are not at all fastidious. They lay their eggs practically anywhere, either in the shelter of overhanging rocks or quite in the open, though the rock-shelters are preferred.

As one passes by a sitting bird, she emits a short hoarse bark, and crouching lower to protect the egg with her breast, pokes up her beak and makes a vicious lunge at the intruder: as long as danger threatens she remains on the *qui vive,* incessantly twisting her head first on one

side, then on the other, in a most ludicrous way. If there are young, she behaves quite savagely: the bark is louder and more prolonged, and she threatens the offender with widely open mouth, remaining at her post even until forcibly ejected. A crowded breeding camp may thus become distinctly 'unhealthy', and the tenderfoot visitor would do wisely to encase his legs in leather.

All sides of the island were occupied, and every likely spot from the sea to the top of the peak. Nesting birds were common even in a long damp cave on the west side of the island, where direct sunlight never or rarely enters. In this cave, each nest was composed of a heap of pebbles, without sticks or any other accessories. However, when it is available, penguins like to scrape together a few sticks or dried leaves as substratum for their eggs, and the dead stalks of Mesembryanthemums were commonly employed for this purpose by the birds on the hillside.

Their readiness to adapt themselves to circumstances is seen on comparing the rookery at Dassen Island with that of St. Croix. Writing on a visit to Dassen Island, Mr. W. L. Sclater says:—"Everywhere the ground was riddled with short wide burrows, not more than a foot or so in depth, and each of these burrows was the home of a pair of penguins." On the other hand, there are no burrows at St. Croix, for the nature of the terrain does not admit of burrowing. In only one solitary instance could I find anything of the kind: this was in the cave, where an enterprising bird had almost buried itself in stinking guano. However on Bird Island, which is also in Algoa Bay, the burrowing habit prevails. In the above mentioned cave, all the birds, except very few at the end of the cave were sitting on nests, one on each nest. I assumed that all the sitting birds were females, and the few pedestrians, males, but most writers say that the parents share the duties of incubation. Outside also, as a rule, only one bird was found on each nest: occasionally two birds were sitting together. Not more than two eggs were found under any one bird, and sitting birds

sometimes had neither eggs nor young. On one occasion I found a very small egg in a nest: it measured only 1·65 x 1·37 inches. This I took to be the first egg laid by an adolescent individual.

The cave-dwellers were remarkably quiet. Entering the cave, not a sound was heard and not a bird moved: even when rudely expelled from their nests, the victims waddled off in silence, except occasionally when a bird would remonstrate with a feeble bark. Under the depressing circumstances of cave life, the avian inhabitants seemed to suffer from reduced vitality: they were greatly infested by external parasites of various kinds, probably more so than birds living in the open country.

Nesting birds seemed to be very conscientious sitters. I saw nothing to indicate that such birds ever shared the jaunts of their touring relatives, or left their nests for any purpose. At the time of our visit we found eggs and young in all stages of development. The young evidently remain under the protection of the parent until they reach a considerable size.

C. J. Andersson (in 'Birds of Damaraland') was informed that they will remain one or two months without going in search of food, and that the young birds remain on land until they are well grown, and do not follow their parents until able to provide for themselves. He also remarks that the bird sits quite upright on its egg or eggs which it keeps close between its heels and tail: this certainly was not the case at St. Croix, for every bird sat over its eggs in the usual avian style.

On the Guano Islands off the West Coast, penguins rule their lives by seasons: the year is divided into a breeding season spent on land, and a feeding season devoted to fishing, when they roam the seas for many miles. At St. Croix, the breeding period seems to be particularly prolonged. Mr. Messina informs us that "the majority of the birds leave the island about August in very poor condition, and begin to return about November, as fat as butter."

Concerning the nurture of their young, I was unable to make observations. However, from observations made in the gardens at Paris, it is now known that the Cape Penguin feeds its young much in the same way as Cormorants—by degorgement of half-digested food from the digestive tract of the parents.

Amongst young birds there is considerable mortality, judging from the dried up carcases found here and there. Our suspicions fell on the older birds, for despite the 'unco guid' appearance of typical penguins, the rival occupants of a breeding camp are quarrelsome and cruel. However, I have since learnt from Canon E. Ford that the sly Sea-gull is responsible for the wholesale slaughter of young penguins; when he visited the island on July 25th of this year, the dead bodies of eviscerated penguin chicks were found in hundreds. Hampered by such a drain on their machinery of reproduction, it is fortunate that Nature has endowed these birds with the capacity to lay eggs more or less continuously. The same prodigality is manifested amongst the penguins of the Antarctic region, for travellers tell us that the chicks of Emperor Penguins perish in large numbers before shedding their downy plumage, being actually nursed to death by parents and rival foster parents, whilst the Adélie Penguins fall victims to the marauding Skua gulls.

In our tramps on the hillside, we noticed considerable numbers of pebbles, mostly small, but some of moderate size. These clearly had not been formed in situ, being no doubt of marine origin. It occurred to Mr. Walker that pebbles may possibly be esteemed by penguins as grit, and are thus conveyed to their present positions in avian stomachs. Although such pebbles were not seen to any great extent near the nesting birds, nevertheless I also think they must have been carried in some way by penguins. In a note by the late Sir John Murray on

Spheniscus magellanicus (Challenger Report, vol. II.) there is a humourous explanation of a similar habit:—'In their stomachs were fish bones, cuttlefish beaks, and pebbles. It is quite astounding the number and size of the stones, shells and pebbles which were noticed lying about the mouth of the burrows. The sealers told me that these birds, when they come up from the sea vomit up these stones at the mouths of their burrows and when they go to sea again they take in the very same stones as ballast'!

The penguins of St. Croix enjoy life undisturbed by man or beast: their eggs remain untouched, and the little guano they produce is not collected. For many years the eggs were systematically collected, but apparently the profits were small. The guano problem is not simple, owing to the steep slopes and rocky terrain. If these accommodating birds could be persuaded to live and breed in well levelled kraals, instead of seeking the inconvenient sites they now frequent, the problem would be solved!

The penguins found at St. Croix belong to the species *Spheniscus demersus* Lin., the 'Jackass Penguin', or Black-footed Penguin, only known from South Africa. The species occurs most abundantly on certain islands off the west coast, extending northwards as far as Cape Cross. The nearest ally is *Spheniscus magellanicus*, found on the Falkland islands, a species which by some authors has been regarded only as a variety of *S. demursus*. Judging from the coloured illustrations of the two kinds in the 'Challenger Report', vol. II., by P. L. Sclater and O. Salvin, they would appear to differ considerably. I have therefore been interested to find, amongst our specimens in the Albany Museum, one example taken at Pt. Alfred, which presents a feature characteristic of *S. magellanicus*: it has a black band on the foreneck, between the horse-shoe-shaped chest-band and the black throat patch: however, the black band

stops short on each side instead of passing into the black of the hind neck as in the S. American species. This unusual character was not noticed in any of the St. Croix birds, though I did not specially search for it at the time. In one respect, at least, the St. Croix birds differ from the typical Cape Penguin as commonly described and figured. There is a characteristic pink patch starting from the base of the bill and extending over and around the eye. On the other hand, according to Mr. W. L. Sclater in his 'Fauna of South Africa, Birds,' vol. IV., the Cape Penguin has 'naked skin about the eye grey, at the base of the bill usually pink, sometimes bluish' The coloured illustration in the 'Challenger Report' also shews the eye encircled by a blue-grey patch, and the pink limited to the loreal region: in reference to their plate, the authors remark:— 'the species is well known to us, and when adult they never fail to arrive at the plumage shewn in the Plate'.

In the 'Ibis' there is a note by Mr. G. Shortridge on penguins at Port St. John's, as follows:— 'I kept a specimen of this penguin alive for some time, and observed that the skin around the eye and at the base of the bill varied very much in colour, being sometimes pink and sometimes almost bright blue'; from this, we may infer that the loreal and circumocular regions were coloured alike in the St. John's bird.

At St. Croix I had abundant opportunities of closely inspecting nesting birds, but have no recollection of blue or grey markings in any specimen.

Although agreeing closely in all other respects, it seems possible that the Eastern Province birds can be distinguished from a western form in sexual plumage by the extension of pink colouration all round the eye: but this eastern variety occurs also at Dyer Island according to information received from Mr. K. H. Barnard. It is noteworthy in view of the fact that the Falkland Island birds also have the pink colours extending around the eye.

Other birds seen on the island were surprisingly few in species: they were Gulls, Oyster-catcher, White-breasted cormorant, Black cormorant, Common wagtail, and a single Rock-pigeon. The Southern black-backed gull loved to perch high up on the tops of rocks, always, we thought with an eye on the nests of penguins or cormorants: its behaviour seemed distinctly suspicious as an egg poacher. Mr. Messina says he has seen one prod its beak into a penguin egg and fly away therewith!

Edward Walker was lucky enough to find a large breeding colony of White-breasted Cormorants. It was situated on the top of precipitous rocks on the east side of the island. Altogether, there were about 30 nests, side by side, each a formidable pile of sticks—dried up *Mesembryanthemum* stalks—about a foot high and nearly 2 feet in diameter: straw and even bits of rope were found in the lining of the nest. There were not more than 3 eggs in any nest, and many nests were vacant. The birds themselves were very shy, and I did not see them sitting. The breeding season apparently had only just commenced, all the eggs being fresh.

Apart from birds, we saw only three species of vertebrate animals on St. Croix. The commonest is the Girdle tailed lizard, Zonurus cordylus. It exists in great numbers, being far more abundant on the island than in any locality known to me. Although common enough near Grahamstown, its population there is kept within reasonable limits through the depredations of birds of prey—especially Kestrels, according to Mr. Frank Bowker; but at St. Croix, its natural increase would seem to proceed unchecked. We noticed these lizards running with impunity amongst the penguins, the latter ignoring them completely. Yet, although they would seem to have no foes, they are nevertheless just as timid and elusive as their much harrassed relatives at Grahamstown. The St. Croix variety is not quite the same as that found near Grahamstown: it is smaller,

the head is not so broad, and it lacks the brick-red colours that are invariably associated with Grahamstown specimens when adult.

A little gecko also occurs at St. Croix, but is not abundant. It belongs to a species (*Pachydactylus maculatus*) which occurs commonly under stones near Grahamstown and throughout the coastal districts of the Cape.

A more familiar creature was captured in the act of raiding our stores. This was a House-mouse. I have carefully compared specimens with the skins of Grahamstown mice, and am satisfied that they belong to a distinct race. The St. Croix house-mouse is a darker animal, having the upper surface of the tail almost black, though several of its toes are almost pure white. It probably belongs to a foreign variety introduced in shipping. Edward Walker and myself observed specimens apparently of the same creature far away amongst the haunts of the cormorants. It is thus quite wild on St. Croix. I may add that the house-mouse in Grahamstown does not run wild: I have trapped for rats and mice on the adjacent veld, and have often taken the domestic rat but never the house-mouse. The severe competition of the African veld is too much for this prolific pest of towns.

Bats are said to occur in the big cave, but none were seen by us, though we searched for them.

Mr. Walker and his son devoted their leisure hours to the fish fauna, and it is gratifying to be able to record that the specimens caught were utilised to the last cubic inch. I first carefully removed the skin of each specimen for preservation in the Albany Museum, and afterwards the flesh became available for the cooking pot or for bait.

The evening captures were mostly dogfish or small sharks of two kinds—the larger fellow with longitudinal stripes known as Lui-haai (*Scylliorhinus africanus*), and

a smaller kind with ocellated spots over the upper surfaces of body and fins. At the time, I regarded these two as essentially the same, the spotted kind appearing to be the young of the Lui-haai: the same view was held by Dr. Gilchrist, when he published his first list of S. African fishes. However, according to Mr. C. T. Regan of the British Museum, they are quite distinct species, and Messrs. Gilchrist and Thompson have recently acquiesced to this view. No less than four species of this genus were recorded by Mr. Regan from the neighbourhood of Bird Island, but the relationships of these four to each other should perhaps be regarded as *sub judice*: the markings on the spotted kind are very variable, and the young of the striped Lui-haai may prove to be spotted.

The invertebrate life of St. Croix consists partly of insects associated with or parasitic on Penguins. The commonest beetle is a small black Tenebrionid of the genus *Gonocephalum*. There are also numerous tok-tokjes, those real Afrikander beetles of the genus *Psammodes* (cp. *P. vermiculatum*). Various Staphylinids and a small Histerid of the genus *Saprinus* were found on the nesting sites. Butterflies are represented by *Colias electra*, and several small species of *Lycaena*. Two kinds of ants occur, one of them extraordinarily abundant: the latter is identified by Dr. Arnold as *Pheidole punctulata*, and the other *Solenopsis punctatoceps*. Several specimens of a small cricket (*Gryllus*) were taken.

I spent some time collecting parasites from the nests of the cave dwellers. By scraping away several heaps of pebbles for examination in a better light, quite a host of ticks was found. They resemble fowl ticks in habit, the adults hiding in the darkest situations they can find, and feeding on the host only for short periods. According to Mr. Lounsbury, it is a favourite joke amongst the

labourers on the Guano Islands to place these ticks in the beds of new comers!

In view of the American relationships of our penguin, it is noteworthy that the ticks (*Ornithodoros talaje capensis*) also have their nearest allies in the New world, and are not directly derived from the abundant tick fauna of the African mainland. The typical form of *Ornithodoros talaje* is recorded from Venezuela, Guatemala, New Granada, Mexico, Panama, Brazil and Chili, where it is reported to dwell in native houses, causing considerable annoyance to the inhabitants: at Panama it specially infests rats. The Cape variety occurs at St. Paul's Rock and on Siren Island (in the Indian Ocean), and doubtfully also at Tristan da Cunha, but the Jackass Penguin is not found in any of these localities.

A satisfactory interpretation of these facts of distribution seems to demand the hypothesis of a former bridge of islands, or even a continuous land connection between the great land masses of Africa and S. America: that a connection did exist in the far remote Devonian period is generally admitted by geologists, and Prof. Schwarz who has designated the Devonian atlantis as Flabellites-land in allusion to the characteristic fossil *Leptocoelia flabellites*, tells us that the fossils of the Falkland Islands are such as might have been collected at Ceres in Cape Colony: there is some evidence that the ancient connection, dating long before the ages of terrestrial vertebrates, may have persisted in attenuated form right up to the beginning of the tertiary period, the age of mammals and birds, but this is not so widely accepted by geologists.

In the same nests I found also several large fleas, numerous Acarines, Staphylinid beetles, and strangely enough small caterpillars. These depraved caterpillars must have fed either on feathers or excrement. Their

progenitors were small plain-coloured moths that fluttered weakly about the cave, avoiding the light.

I had hoped to find false-scorpions on the nesting sites, for such creatures frequent birds' nests and the haunts of dassies or other mammals: but, I found none at St. Croix, nor any true scorpions.

Various spiders were found, but all of the 2-lunged type. The 4-lunged spiders including large baviaan spinnekop and trap-door spiders which abound on the mainland, are not so readily dispersed by winds as are their 2-lunged relatives. Under stones on the hillside, I found several species of Oonopidae, amongst which was a Grahamstown species described by myself some years ago as *Gamasomorpha australis*.

The most interesting spider taken was a large specimen of *Desis pentheri*, a long-jawed creature of submarine habits: at high tide it dwells in sheltered retreats amongst rocks beneath the waves, emerging only at low water. I found it crawling over a boulder at the entrance to the cave.

There were no millipedes, nor centipedes, but the long slender Geophilidae were fairly common.

After a very successful and pleasant trip, we returned to Port Elizabeth in one of Messina's fine tugs. Mr. Messina informed us that St. Croix was once the centre of a whaling industry, and was occupied for a long time. Yet, from a residential standpoint, the island has serious limitations, for there is no fuel and little, if any, fresh water. Mr. Messina reported the occurrence of tolerably good drinking water in a certain cave, a point of some interest in view of the fact that the island actually visited by B. Dias did afford him springs of fresh water, according to the somewhat confused account of the historian de Barros. Sundry attempts have been made to discredit the identity of St. Croix with Bartholomew's island of the Cross, but the identification seems to me very probable. I can now understand why it should prove so at-

tractive to mariners: perhaps they found penguin eggs and young birds an agreeable addition to their monotonous fare!

Mr. Walker has referred me to a significant passage in the account of the first voyage of Vasco da Gama (1497). Concerning the penguins of Mossel Bay, the ancient writer says:—'There are birds as big as ducks but they cannot fly, because they have no feathers in their wings. These birds, of whom we killed as many as we choose, are called Fotylicayos, and they bray like asses.' This presumably is the first reference in literature to penguins, although they may have been actually discovered in 1485 by Diogo Cao at Cape Cross.

Another point in favour of the accepted identification of this island has been emphasized by Canon E. Ford,—that St. Croix undoubtedly affords the safest anchorage in Algoa Bay.

I completed a round of thrilling experiences by visiting the new Museum at Port Elizabeth. The recent improvements in the exhibited collections were all thoroughly appreciated. I also saw the famous serpentarium, and along with other visitors, experienced the charm of the Serpent!

The Egg-laying of a Chameleon.

By H. E. Schoch.

On the morning of the 20th February my native servant drew the attention of my wife to a full grown and much distended chameleon which was frantically trying to dig a hole in a bare patch of my flower garden. Its action was rather peculiar as, being unable to scratch in the ordinary way, it first formed a small earthen ball with its one fore foot, deposited this ball as far back as possible, then picked it up with its hind foot and placed it still further back; this constituted a rather peculiar double action. When it got tired of working in this fashion with the two right feet, it changed to the left and continued the performance. In digging it encountered a stone, so my wife pushed the chameleon aside and removed the stone and the reptile immediately resumed its digging.

By sunset the chameleon had dug an inclined shaft over a foot in length, the lower end being about eight inches vertically below the surface of the soil. In this hole the chameleon curled itself up and deposited its eggs.

Early the following morning it started filling up the hole, completing this by about noon when, although I knew the exact spot, it was almost impossible to see that the soil had been in any way disturbed. There was no trace of loose soil about but bits of grass and leaves were scattered around so that the spot looked exactly like the surrounding surface. I carefully marked the place and, as I did not know the period of incubation of chameleon eggs, I daily inspected it.

In the meantime the chameleon, now very thin, remained in an adjoining rose bush. We found that, owing to the clayey nature of the soil in which it had been digging, it had a ridge of clay extending from the top

of its head to below its mouth and its feet were also clogged. As the clay got dry the chameleon could neither open its mouth nor climb. My wife and daughter therefore softened the clay with luke-warm water and then scraped it off, replacing the chameleon in the rose bush, where it remained till the following day noon, when I saw it walk away.

On the evening of the 13th March, exactly twenty-one days after the eggs had been deposited, I noticed a circular hole about half an inch in diameter at the spot where the chameleon had dug. The small hole had evidently been made from below, upwards, as there was no trace of loose soil on the surface, so I presumed that the eggs had hatched, although at the time I could not find any young chameleons. I waited until the 16th March when the small vertical hold had fallen in and by that time we had found four quite small chameleons on the surrounding shrubs and in the grass. These young ones had a comparatively large head and a very slender body and a thin long tail, a jaunty jerky action and the same faculty of changing colour as possessed by full-grown chameleons. The length of these small chameleons, measured from the tip of the nose to the tip of the tail, was about one and three-quarter inches. There may have been more young ones about but so far no others have been found.

As the small exit hole from the nest had been closed for some days I assumed that all the eggs that were fertile had hatched. Being curious to find out how many eggs the chameleon had laid, I dug out the nest on the 16th March, when to my astonishment I found clusters of eggs interspersed with soil. A few eggs had got broken during the digging operations and three were opened to see if they were fertile, but I found them all barren. I then carefully counted the eggs and shells or skins and found there were no less than seventy, of which sixty-four were intact. There may have been a few more but I did not search further. I buried most of the eggs in

the old nest, but kept out three of average size for the purpose of measurement. The eggs are like a round hen's egg, the long axis measuring half an inch. They are encased in a tough white skin which has a tendency to harden when exposed to the air. The eggs varied slightly in size but the difference is small.

What struck me most was: (a) that a chameleon, so ill-adapted for the purposes, should be able to dig such a deep hole in very stiff clayey soil; (b) the number of eggs laid; on seeing their size and number it seemed almost incredible that they could have been laid by one chameleon, unless these eggs swell considerably after being laid; (c) how the young chameleons can work their way to the surface through from six to eight inches of clay.

Larval Trematodes from some Fresh-water Snails.

By F. G. Cawston, M.D. (Cantab).

Whilst examining the fresh-water snails of Natal and the Transvaal, I have encountered the larval stage of several different species of trematode worm. Some of these develop in freely movable rediae, whilst others develop in sporocysts without the formation of rediae.

At one time I thought that members of the Schistosome group were confined to *Physopsis* but this view has to be modified in view of the isolation of typical Schistosomes from *Isidora schakoi.* These Schistosomes are quite distinct from the Bilharzia which I have found developing only in *Physopsis africana* and Mr. Hewitt of the Albany Museum at Grahamstown suggested that they might be a parasite of the water-rat. They are not altogether unlike a cercaria which infests *Physopsis* at Pietermaritzburg which, according to Dr. E. Warren, has the appearance of an avian trematode.

In various parts of South Africa sheep are heavily infested with the liver-fluke parasite. I have in my possession some from Pretoria and Durban, where I have seen the liver of oxen as well as sheep swarming with these leaf-like parasites. Several of the cercariae that I have obtained from *Limnaea natalensis* are similar to what has been described as the larval stage of *Fasciola hepatica*; another, *C. pigmentosa*, develops into *Fasciola gigantica*.

I found that 30 per cent. of *Planorbis pfeifferi* at the Toll Gate brickfields at Durban were infested with rediae containing a parasite resembling the larval stage of the Lung-fluke. I have collected snails infested with the same parasite from other parts of the country.

Amphistomes are common in cattle and sheep in various parts of the Union. The larval stage of these parasites has not previously been reported in South Africa. However, I found 60 out of 600 *Isidora schakoi* at Potchefstroom infested with *Amphistoma* during the months of October to January 1917 to 1918. The life-cycle of this Amphistome is at present unknown; but the pools from which it was isolated swarm with crabs, an interesting variety splitting off from the well known genus *Potamonautes*.

Dr. Henry B. Ward, the Editor of "The Journal of Parasitology," has kindly had drawn and described for me the two parasites I have isolated from *Isidora schakoi* at Potchefstroom. This genus of snail is notoriously polymorpheus and the species very variable; but Mr. Henry C. Burnup has no hesitation in identifying the specimens I sent him from Potchefstroom as *Isidora schakoi*, for they agree very well with Jickeli's description and figures of *schakoi*.

A.—Study of slides labelled *Cercaria gladii*.

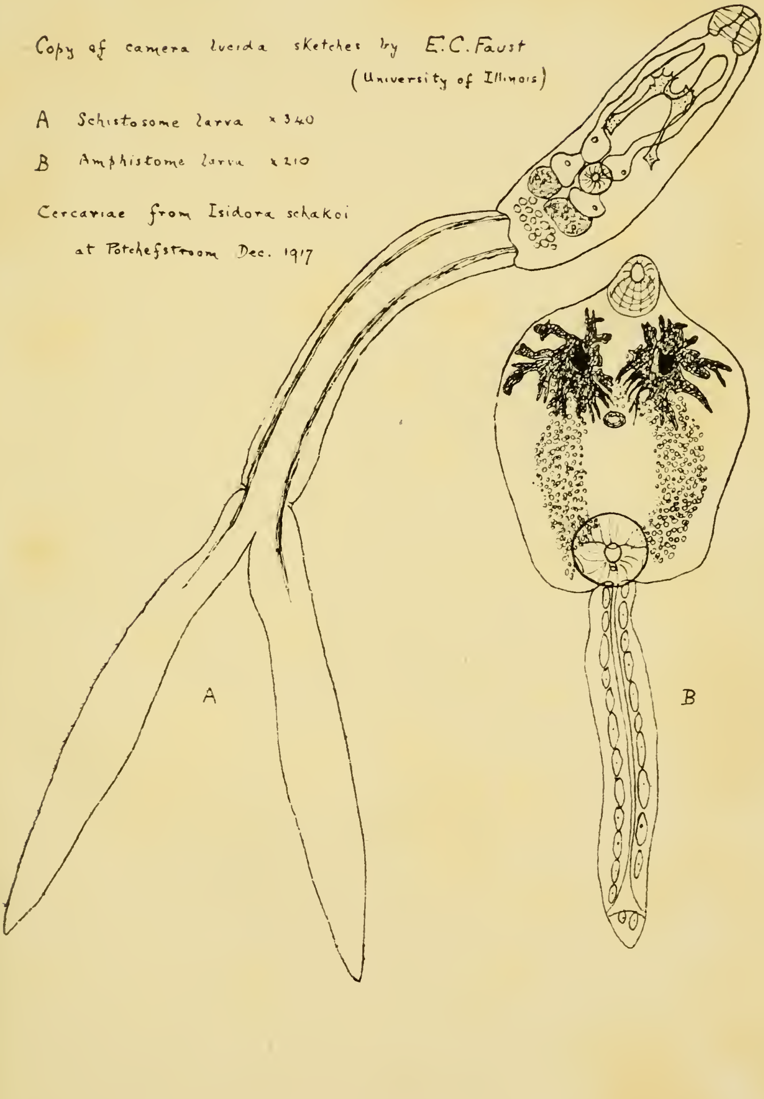
Schistosome larva. Body 250 m. long, 73 m. wide;
Tail 290 m. + 380 m. = 670 m.

Copy of camera lucida sketches by E. C. Faust
(University of Illinois)

A Schistosome larva × 340

B Amphistome larva × 210

Cercariae from Isidora schakoi
at Potchefstroom Dec. 1917



Oral sucker opens into single median rhabdocoel pouch.
Three pairs of salivary mucin glands empty into anterior region of pouch.
Acetabulum in posterior two-fifths of body, considerably smaller than oral sucker.
Mass of large germ cells in posterior part of body.
Brain mass around posterior region of digestive pouch, with paired brain ganglion masses, and prominent ventral trunks running cysbolad, ending anterior to acetabulum.
Median single portion of tail with prominent longitudinal muscles.

B.—Study of slides labelled *Cercaria frondosa*.

Ampistome larva. Redia-produced.
Body length, 405 m.; width, 310 m.;
Tail, 430 m. long by 57 m. in diameter.

Larva heavily muscular, filled with mass of cystogenous granules.
Oral sucker, 66 m. in diameter, posterior sucker, 95 m.
Bicorniate excretory bladder with small dorsal pore.
Lateral excretory trunks dilated with large granules.
One branch of the trunks runs forward outside the eyespots.
Cross branch just behind eye-spots.
Eye-spots two, distinct, surrounded by frondose arrangement of pigment.
Small group of germ cells immediately posterior to transverse excretory canal.
Caudal excretory trunk opens externally on right and left, near distal end.

False Scorpions.

By the Revd. Robert Godfrey.

False-scorpions constitute a compact and well-marked group of animals, representatives of which are found everywhere in our land. The number of South African species at present known, to the South of the Zambesi, is about sixty, but, when more exhaustive investigations have been carried out, this number ought to reach a hundred at least. It is safe to say that in any part of the land a naturalist may find a dozen species within a radius of ten miles from his home. Some districts have undoubtedly many more; the number known from the Cape Peninsula is fourteen, from Tsolo division nineteen, and from King William's Town division twenty-nine.

These creatures, as their name implies, superficially resemble true scorpions, but are at once distinguished by their having rounded hind-bodies destitute of sting. They are of small dimensions, some of our local species measuring less than a millimetre in length and the largest attaining a length of six millimetres.

Except in the case of the so-called "little red crab," our South African species are not popularly known, but the excepted species, known scientifically as *Chelifer sculpturatus* Lewis, will serve as an introduction to the group. This species has attained notoriety from its association with our bees and is known to observant beekeepers all over the Union. The "little red crab" attracts the attention of the beekeeper when he exposes his sections to the light of the day, and the sight of it raises queries in his mind as to the lawfulness of its presence among his bees. No beekeeper, however, seems as yet to have discovered the part played by the "crabs" in the economy of the hive.

In Europe the blind *Chernes nodosus* Schrank, attaches itself to the legs of flies and is carried hither and thither at the will of the fly; as many as six have been found clinging to a single fly, hanging doggedly on in spite of the efforts made by the fly to dislodge them. I have seen a similar occurrence in South Africa. On 29 January, 1915, at Pirie, while at our morning hymn, I noticed on the white tablecloth before me a fly with a false scorpion attached to its legs. With ill-suppressed excitement I watched the fly within tantalising reach of my hand, and I saw that the false-scorpion belonged to one of the smaller species. As it clung to the fly's leg with the fingers of one of its long nippers, it kept its fore-body drawn up closely to its nipper, thus exhibiting the great muscular strength of the nipper. At the close of the hymn I tried to capture the fly but failed; and in spite of all attention bestowed on the fly papers thereafter the prize was not secured. False-scorpions are beasts of prey; and it would appear—although this is not fully proven—that the little false-scorpion grips the fly with the purpose of sucking it, but, being too small and helpless to accomplish this object at once, it simply hangs on to the fly till the death of the fly affords the false-scorpion his long-expected meal.

This "little red crab" is carried about from place to place, clinging to the leg of a bee, but in the hive it moves about freely unattached. It would appear to be a social ally of the bees, depending on them for transport from place to place, but not actually preying on them. It is much more likely to be living on tiny parasites in the hive and therefore to be reckoned as a friend of both bees and bee-keeper.

Other species strike up relationships with other groups of insects; *Chelifer termitophilus* Tull. lives in termite-heaps: *Myrmochernes africanus* Tull. is found in the nest of an ant; and, in South America, two species live under the elytra of beetles.

In South Africa false-scorpions may be confidently looked for in any natural piece of ground or bush and even in stables and orchards. They range from the tide edge to the tops of the mountains and are found in all kinds of situations. One species lives in the fissures of the natural rock at high-water mark, where it must sometimes be under the influence of the sea-spray; and it is quite likely that here, as in Europe, there are species living between tide-marks and waiting to be discovered by some enthusiast.

Many species live in the bush-country, some on the ground among the dead leaves, others in the crevices of the bark on trees, and at least three species are found closely attendant on man in stables and hen-houses and other out-buildings. Few stables of old standing are destitute of these tenants; the accumulated litter of stable refuse lying behind and beneath mangers is a much loved haunt and the stones embedded in the stable floor often harbour these creatures on their under-surfaces.

As an attempt is being made to work out the distribution of our South African species, this short article has been written to induce readers to collect and to forward specimens, either to myself or to Mr. John Hewitt, Directory of the Albany Museum, Grahamstown. The specimens are best kept in alcohol in small tubes, and should be sent in a box strong enough to pass in safety through the Post Office.

The Jumping Bean — Emporia melanobasis, Hmpsn.

By A. T. Janse.

The Jumping Bean is too well known to make it necessary to describe the external form of the seed. It is not a bean at all, but the schizocarp of a plant belonging to the *Euphorbiaceae*. It is by no means confined to S. Africa, but occurs also in N. America and S. Europe, in fact it was known from Europe as early as the beginning of the sixteenth century, but it does not seem to have attracted as much attention then as it has done during the last years. In 1854 a "jumping bean", resembling in every respect the one found in South Africa, was found in Mexico and well studied by the well-known entomologist Lucas, whose observations are very conclusive. It was only since 1896, however, when these "beans" were imported from Mexico in such large quantities, that they became more known by the public that bought them from mere curiosity. And no wonder! The jumping of these beans is a most weird spectacle. This peculiar movement in the seed is caused by the larva of a moth.

The Mexican "beans" develop a small moth, that belongs to the Tortricidae and is named by Westw. as *Carpocapsa saltitans*. This genus has in Europe six species, all of which live inside fruit, which they all leave however before pupation, while the Mexican species pupates also inside the fruit.

The jumping beans from South Africa also pupate inside the "bean", at least the species known to me, and the one I know from the Transvaal resembles in many respects the Mexican jumping bean.

The Transvaal "jumping bean" is clearly the fruit of a Euphorbiaceae, and comes from the Lydenburg district,

but I have never had the opportunity of seeing more of the plant than the "beans". It seems that all the fruit are inhabited by the larvae, as a *sound* seed never came to my notice nor to the notice of the collectors who sent the "beans" on to me. I also received far too little material to ask the help of a specialist to identify the plant that produces the fruit. As the generic characters of this family are founded on the structure of the seed, however, it will be impossible to identify the genus except approximately.

The larvae that I found inside differed very little from other larvae that live inside plant parts, except that it was very thick in the middle probably due to abnormal development of the muscular system in that region. When taken out of the "bean", it always maintained a semi-circular position, and the size was certainly too big to allow the full grown larva to stretch itself when inside the "bean". This fact I think of great importance in the explanation of the jumping power of the larva. When the larva came to me they were full grown and the fruit consisted of the empty shell only, yet they remained in this larval stage from November 23rd, 1908, till June next year, when I found the first pupa inside those "beans" that did not jump any more. Some of them even pupated as late as October the 8th, or nearly a year after being apparently full grown. During the larval stage the "beans" jumped every now and then, often to a height of not less than an inch, and when left by themselves in an open shallow box for some days they would all gradually disappear. When about a hundred were confined in a cardboard box they would keep up a rattling noise, that never quite ceased, but that became more pronounced when the box was exposed to heat. I often observed that some of them kept on jumping every two or three seconds for several minutes when a short period of rest would be enjoyed, to begin the jumping again, especially when the temperature was rather high. One naturally asks the use of this movement, but I must

confess, that I cannot think of any use that would justify such a considerable waste of energy, but it still more surprises me that the larva can keep up this movement for several months without any food, not to speak of the quantity of food necessary to bring the young larva to maturity, not more than about twice its own volume being stored in the fruit. The fruit when sent to me were quite sound on the outer surface, not one opening or mark of entrance could be detected by me even with a magnifyer, so I presume that the larva must enter the fruit when the latter is still very young and that the larva feeds on the food brought there by the plantparts concerned, allowing at the same time sufficient food for the proper growth of the outer shell, or the moth must have a means of depositing the eggs into the tissue when the fruit is nearly full grown, but I could not find in the female moths that hatched out any ovipositor that even suggested its capability of performing this. Before pupation the larva cuts a very neat circular hole in the hardest part of the shell, without removing the centre, but this lid is only visible with the aid of a magnifyer and seems to be kept in its place from the inside by a silken surface that covers in fact the whole inside One to two months after these lids are made the moths emerge and in my beans they all were of one species belonging to the Pyralidae family of the genus *Tephris.* The species was before quite unknown to me and most probably new, but the peculiar thing is that the "jumping beans" of other countries contain larvae of moths belonging to other families. The Mexican species is a *Tortrix*, the Transvaal species a *Pyralid* and the other I know from Table mountain is a *Tineid.* This last species is described by Meyrick as *Scirotis athleta,* the only species known of this genus.

As Mr. Meyrick rightly says, these "beans" have nothing whatever to do, with the "beans" from Mexico (nor from those of Lydenburg), as far as relationship is concerned but are more to be looked upon as special ways

of pupation. That the Cape species has parasites need not surprise us, since the larvae live for some time outside the seed, but it is more peculiar that many of my specimens, that I have every reason to believe to have lived nearly, if not all, their time inside the fruit, had Hymenopterous parasites, that bored their way through the thick shell in quite a different manner to that of the moth. I think that these Ichneumons bring their eggs into the larvae by boring with their ovipositor into the shell in such a way that the opening is afterwards invisible.

It was not so much *why* the larva jumped so frequently but *how* they could perform this feat which required such a large amount of muscular power, that puzzled me most. I partly opened several and observed it carefully, in the act of jumping, and I feel sure that the larva first contracts itself, then suddenly stretches itself as much as space allows so as to throw, as it were, the two ends of its body against those walls of the bean that are upwards, at the same time raising itself, and this I think forces the "bean" up for sometimes the height of an inch. Mr. Lucas made very careful observations on the Mexican bean, however, and comes to somewhat different conclusions. In order to observe the larva well, he took one of the flat walls away and placed a small piece of mica in its place. He then found that the larva climbs on to the highest wall, stretches itself till the ends of its body are at the corner of the bean then it contracts its body so that the larva begins to swell, then the body stretches suddenly in the direction of the upper part of the bean and this causes the bean to move in one direction.

I would not like to decide which of the two is the most probable explanation; perhaps there are even several means of producing the same thing: the uncanny movement of what is apparently but a seed.

Obituary.

John Wood.
(Foundation Member of S.A. Biological Society).

By the death of Mr. John Wood of East London on the 23rd December, 1918, the Biological Society lost one of its strongest supporters, and South Africa one of her most valued citizens.

Born in Scotland some 60 years ago, Mr. Wood adopted Banking as a profession and after his arrival in South Africa held important posts in the Bank of Africa at Paarl, Kimberley, Johannesburg and East London, but about a dozen years ago he resigned his post as local manager of the Bank at East London to take over the control of the South African branch of McDougall Bros., the well-known manufacturers of sheep and cattle dip. Although this is not the place to speak of Mr. Wood's business capacity it may be remarked in passing that this position, which he held up to his death, was one peculiarly suited to his gifts and there are many farmers throughout the length and breadth of the sub-continent who gratefully recall his sound practical advice and scientific skill in dealing with stock diseases and plant pests.

Natural History—in the widest sense—attracted him from an early age, for while yet but a youth in Scotland he was spending his holidays field-glasses in hand in the woods and moorlands, and his evenings with the microscope investigating the minuter forms of life found in the lochs and streams of his beloved Perthshire.

Just what South Africa with its teaming wealth of plant and animal life meant to one of his temperament can be guessed and he threw himself into the study of that wealth with a disinterested enthusiasm which is regrettably rare. He wrote comparatively little and it is only when one reads the South African scientific literature of the past 25 years and finds his name con-

stantly occurring as the contributor of some valued specimen or observation that one realises how great a contribution he made to our knowledge. Geology, Palaeontology, Botany, Zoology, Anthropology and perhaps above all Ornithology are all indebted to him. Yet he was no mere collector. Collecting and classifying indeed, were to him a necessary but uncongenial preliminary to true study. We fancy he belonged to an obsolescent order of naturalists who were nature worshippers as well as nature lovers—men who were attracted to the study of science by an intuitive appreciation of the glory and the wonder of the Universe. He was too big to disparage work in any department of knowledge but the soaring of an eagle was to him something more than a problem in aerodynamics and the pollination of an orchid something grander than a phase of evolution. Like most who lived close to nature he had his own philosophy of life of which he spoke but little. To the end he pleaded that our young people might be taught to see and understand the greatness and beauty of all nature—that the poet and the man of science might unite to lead them to that mood which arises out of the contemplation of infinite variety in infinite space—or to use his own last words on the subject, "let them see as much as possible of God's side of the world."

Although as we have stated he had written little, he had accumulated a vast store of first-hand information and recorded his observations in notes which he hoped to arrange and publish when he retired from business in that calm of evening which was denied him. These notes we understand he left to the East London Public Library and it is greatly to be hoped that they may one day be given to the public no less for their scientific value than as a fitting memorial to a great naturalist and a most lovable fellowman.

G. R.

General Notes.

THE DOG AND THE COBRA.

Mr. Fuller's note on the encounter between a mierkat and a cobra induces me to relate an experience which I had some 18 years ago on Table Mountain. In order to carry out some photographic work on the mountain I stayed for a few days with the forester lodged at that time in the cottage now occupied by the caretaker of the Wynberg reservoirs. In front of the cottage was a young plantation of firs, the trees being only about two feet high. Standing on the stoep of the cottage the first morning I suddenly noticed a great commotion among the little trees in front of me and soon recognized that it was caused by a fight between the forester's dog and a snake. The dog was a sort of a hybrid Irish terrier which had preferred to remain on the mountain with the forester instead of following his master when passing there a few days ago. When I recognised the two combatants the dog held the snake at the tail and, rushing backwards through the trees, jerked his head violently from side to side, thus knocking the head of the snake against the trees. Suddenly he let go; instantly the cobra rose and turned towards his foe, but by that time the dog was at a safe distance and barked at the snake. After a few minutes the snake turned and rushed away, but just as quickly the dog had sprung upon him again and repeated the manouvre described before. When tired he dropped the snake; the snake rose, waited a few minutes and tried to get away again, but without success. Gradually the snake became weaker, and after the sixth time he did not rise again. The dog waited a little, seized the snake about the middle of the body and rushed backwards as before until he had reached an open spot. There he dropped the snake, watched him for a few minutes from

a distance and then suddenly bit him in the neck until the head was nearly severed from the body.

How did the dog learn these tactics?

An hour afterwards our little party of three set out for a walk along the Wynberg reservoirs, when to our surprise the dog followed us, although we were perfect strangers to him. About a mile from the cottage the dog suddenly barked furiously and rushed into a patch of tall grass. Some wild struggle followed in the grass until after a little while the dog appeared running backwards, while at the same time a large cobra reared his head above the grass, the hood inflated. The fight between the dog and the snake proceeded as in the morning, and after a quarter of an hour or so the limp body of the snake lay at an open spot, the neck bitten through.

I wondered again how the dog could have learned this warfare, for he was evidently bent on snake hunting and had probably stayed on the mountain for that purpose.

The next day the dog followed us again and killed a third cobra in the same way, thus giving me an opportunity of seeing more cobras on Table Mountain in two days than I have met there during hundreds of visits within the last thirty years.

But the story of the clever snake hunter does not end there. When the dog had finished the third cobra we continued our walk along a narrow footpath; suddenly I saw a bergadder nicely coiled up in front of me. Calling out to my little son just behind me I left the path and watched the dog, being very curious to know how

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Footnote.—For those readers who do not know a bergadder (*Bitis atropos*) I may add that it has a short stumpy tail like a puffadder and that it is only 12-15 inches long, but that its bite is quite as virulent as that of the puffadder. This snake one meets more frequently on the south-western mountains, hence I have destroyed a good many.

he would tackle this adversary. When near enough to see the snake he sniffed at him from a little distance, gave him a wide berth without a single bark and took no further notice of him.

How did he know that this was also a dangerous foe, but that he could not be tackled like the other one? How did he learn to treat the two snakes so differently?

R. MARLOTH.

NESTING OF LARGER STRIPE-BREASTED SWALLOW (*Hirundo cucullata*).

Last year a pair of large Stripe-breasted Swallows nested under the iron roof of the stoep, and of course whenever we had a gale or a hail storm the vibration of the roof caused the nest to come down with a run. The last disaster deposited two well grown youngsters on the ground, and as I wanted to save the poor little beggars I prepared a box and after putting the birds into it, nailed it up in the old site of the nest—both birds were successfully reared and took to the wing in due course. The box I used was about 9 inch by 4 inch of the closed-in cardboard variety fastened at the side by means of tongues and slits, known as a carton, I believe. I lined the box with cotton wool and cut a small hole, about the size of the entrance to the original tunned, at one end before putting the birds in and nailing it up. Now the extraordinary thing is that the old birds have returned this spring and occupied the box again without making any alterations to it, with the exception of a small ring of mud, half an inch round the entrance hole—there is a bird sitting on eggs in the box at the moment of writing.

GURTH EDELSTEN, Sepani, Tvl.

RINGED STORK.

Mr. J. P. Murray reports the finding in February of this year, of a ringed stork by Mr. Yeats near Thaba

Besin, about fifteen miles S.E. of Maseru, Basutoland. This is an interesting case as the ring bears the legend:

ADDRESSE: MORTENSEN
VIBORG, 1123 M DANMARK EUROPA.

Mr. Murray adds, as a matter of interest, that the Basutos call the stork "Mokotatsie" (Mo-kó-ta-tsi-è). The word is derived from Kobo = to peck and Tsie = a locust. The native doctors prize the stork for the manufacture of their medicines. Basutos eat the flesh although they do not consider it a delicacy and say it tastes like horse flesh.

Suicide of Scorpions.

Dr. Breijer's note on the suicide of a Scorpion, printed in the first number of the Bulletin, is of interest as recording the only evidence he could obtain in justification of the popular belief in scorpion suicide The graphic language quoted by Mr. C. N. Knox-Davies from Byron — "The sting she nourished for her foes, whose venom never yet was vain, gives but one pang and cures all pain, and darts into her desperate brain" — may appeal to the heart of a poet, but fails to inspire confidence in the author's knowledge of scorpion habits and anatomy.

More than 30 years ago, a series of experiments was devised to test the truth of the popular belief by Mr. C. Lloyd Morgan who recorded his results in the Transactions of the South African Philosophical Society for 1883. Mr. Morgan experimented in Cape Town with two local species (not identified but apparently *Opisthophthalmus capensis* and a species of *Ihoplectes*.) The experiments were somewhat drastic and no less than 60 specimens were sacrificed thereto; but the conclusion was "that neither of the two species on which these experiments were made have any suicidal instinct." The victims were submitted to such treatment as the follow-

ing:—The rays of the summer sun was focussed on the back of the creature until death: others were slowly heated in a glass bottle, when quite commonly the sting was passed over the body as if to remove some irritant and poison exuded from the sting: some were surrounded by a circle of fire, others were dropped into strong acids or alkalies, they were drowned in water, alcohol, ether, tormented with burning phosphorus, electrified by strong shocks and lastly, 9 specimens were pierced by the experimenter with their own stings. At an evening meeting he exhibited a specimen along with this statement:—"The scorpion I caught at 11 o'clock this morning: I at once pierced him in three places with his own sting on which in each case was a drop of poison. In the last inoculation, I held the sting in the wound, and squeezing the bulb of the sting with the pincers forcibly ejected poison. The creature is alive and active!

It seems to me that the behaviour of Dr. Breijer's scorpion is capable of another interpretation. The self-inflicted wound may have been accidental, although this possibility was considered and rejected by the experimenters. It was explained that the offending 'stick was attacked furiously by the sting' before the accident occurred: thus the creature may have suffered from fatigue, and the ill directed blow that pierced its own skin instead of the stick may have missed its mark through nervous or muscular exhaustion. However this may be, a more vital point is the actual cause of death. Is it not possible that death was caused by the entry of strong spirits through the wound?

The question is of considerable interest from an evolutionary stand point. Scorpions are of extreme antiquity, dating back to the Silurian period and thus long preceeding the earliest vertebrates. If the sucidal habit really is general amongst scorpions, there has been perpetuated a character detrimental both to individual and race. Whilst murder and cannibalism amongst animals may have value in establishing a virile race,

suicide has nothing to recommend it, unless it should happen that self destruction is the habit only of weaklings. If it can be shewn that scorpions deliberately sting themselves with fatal consequences under any circumstances to which they may be subjected in nature, the case will witness strongly against natural selection as a prime factor in evolution; however, according to modern views, the importance of Natural Selection has been somewhat overrated, and thus theoretically scorpion suicide comes within the range of possibility.

JOHN HEWITT.

Albany Museum,
Grahamstown.

THE STIMULATING INFLUENCE OF CERTAIN GASES ON INSECT PUPAE.

During the years of 1914-15 when the writer was engaged upon some fumigation experiments against the Angoumois grain moth (*Sitotroga cerealella* Zell.), a peculiar effect was noticed. Hydrocyanic acid gas was used, but even at strong strengths it did not readily penetrate the grain, consequently the pupae of the insect were not killed. However, a small amount of the gas did penetrate the grain but instead of injuring the pupae it apparently exerted a stimulating influence upon them, with the result that in most cases moths issued from pupae in grain that had been subjected to fumigation sooner than from those in grain that had not been exposed to the gas.

In 1918, one fumigation test with sulphur dioxide was made. The strength of gas used did not prove sufficient to kill the pupae. It was noticed in this case also that moths issued from the grain that had been fumigated, sooner than from an untreated check lot. Recent experiments indicate that weak strengths of carbon bisulphide will probably have the same effect, but this is not altogether certain.

It is well known that humidity, temperature, etc., influence the length of the various stages in the life history of insects, and from the above it would appear that at least under some circumstances certain gases are capable of the same thing.

W. F. Schlupp, Entomologist,
Government Experiment Station,
Potchefstroom.

A New Parasite of the Wax Moth.

The larger Wax Moth (*Galleria mellonella*, Linn.), has been fortunate in having comparatively few parasites. Up to the present three parasites (hymenopterous) have been recorded. Roudani found the chalcid *Euphelmus cereanus* parasitizing the larvae in Italy; Marshall recorded *Bracon brevicornis* from France, and recently A. Conté has found *Apenteles lateralis* to be rather an important parasite in the same country. Paddock has reported a small red ant (*Solenopsis*, sp.), as being a predaceous enemy of both larvae and adult moths in Texas, U.S.A.

In the latter part of 1915, the writer obtained some larvae of the larger Wax Moth from an infested hive at the Experiment Station, Potchefstroom. These were placed in breeding jars and later on the cocoons yielded a number of ichneumons These were recently identified by Dr. Péringuey of the South African Museum as *Pimpla spiloaspis*, Cam. The parasite is a useful one, but it cannot ordinarily be depended on to hold the wax moth in check.

W. F. Schlupp,
Government Experiment Station,
Potchefstroom.

Fabre on Parthenogenesis.

Extract from American Bee Journal, May, 1918

Those of our readers who have been with us for several years will remember, perhaps, the writings of the celebrated naturalist, Fabre, and his great observations upon the bee-eating wasps, the *Philanthus apivorus*, and his description of the digger wasps, such as the sphex, the scolia, the pompilus; the scientific way in which these insects sting their prey sufficiently to render it unable to defend itself and yet live until it is eaten by the young larva of the digger wasp. (*American Bee Journal*, September and November, 1912.)

Fabre's writings are exceedingly interesting, for although, he was a botanist and an entomologist, his descriptions are as devoid of scientific words as he could make them. Besides, he spent but little time describing the anatomy of the insects. Of this he gives just enough to explain their actions. He was really a naturalist, studying the habits and ways of all these insects and describing what he saw in a delightful manner. The reader of his books accompanies him in his researches, so vivid are his descriptions. His entire life was spent watching the small but innumerable world of insects.

I bought his "Souvenirs Entomologiques" in his native language, the French, and am spending really delightful hours with him among the hymenopters. But although he spent years among the different varieties of bees, the honeybee seems to have been neglected by him, for he mentioned only its enemies, the digger wasps. It was, therefore, with great astonishment, that I found, in the last chapter of the 3rd volume, a reference to Dzierzon and parthenogensis. It came in the following way:

In describing the "osmia", a family of mason bees, he explains the repartition of the sexes in the different cells. In this bee, the male is smaller than the female, just the opposite of our honeybee, if we consider the

worker or neuters. But as the female osmia are all fully developed females, the comparison between them and their males is not in very great contrast with that of our queens and drones. The females are hatched in cells measuring about one third more than those in which the males hatch. Fabre wonders, as we do, at what causes the sex of the egg and concludes that it is entirely left to the decision of the mother. But as to what determines her decision he remains ignorant, He writes .

"There remains to be told in what manner is made this facultative determination of the sexes. I know absolutely nothing about it. If I ever learn anything upon this delicate question, it will be due to some happy circumstance for which I must wait. Towards the end of my researches, I became acquainted with a German theory concerning the domestic honeybee and due to the apiarist, Dzierzon. If I understood it well, according to the incomplete documents before my eyes, the egg such as it is, supplied by the ovary, already has a sex; always the same; it would be originally male; it is by fecundation that it would become female The males would be the result of non fertilized eggs; and the females of fertilized eggs. The queen bee, therefore, would lay female or male eggs according to whether she did or did not fertilize them, as they passed through the oviduct.

"Coming from Germany, this theory inspires me with profound distrust. As it has been admitted, with rash precipitation, even in classic books, I will surmount my repugnance to investigate Teutonic ideas and will submit it, not to the proof of arguments against which a contrary argumentation may always arise, but to the irreversible test of facts."

Fabre then goes on to explain that, according to the Dzierzon theory, the egg passes by the spermatheca which contains the seminal fluid and may not have its sex changed by the action or inaction of this fluid, becoming a female or a male, the sex being thus determined, at the will of the layer by a pressure upon the spermatheca.

Now comes the experience upon which he bases his denial of parthenogenesis:

"The Osmia, born industrious dies working. When her ovaries are drained, she spends the remainder of her strength in useless labour, partitions, lids, hoards of pollen without use. The living machine cannot accept inaction, even when there is nothing to do. It continues its functions in labour without purpose. Let me point these vagaries to the adepts of the reasoning power of beasts.

"Before reaching these useless labours, my belated workers have laid their last eggs, the location and date of which I know positively. These eggs do not differ in any particulars from their elders. They have the same dimension, form, gloss and appearance of freshness. Their supplies have nothing exceptional, either, and are very well suited to males, closing the laying. And yet, these last eggs do not hatch, they shrink, wilt, and dry up on the stores of food. At the terminal egg-laying of some osmia I count 3 or 4 sterile eggs; with another 2 or 1. Another gives fertile eggs to the last.

"These sterile eggs, touched with death from their first appearance, are too numerous to be unnoticed. Why do they not hatch like the others which they so resemble? They have received from the mother the same care, the same victuals. The investigations of the magnifying glass show nothing that can explain the fatal issue."

If our mind is free from preconceived ideas, we go straight to the explanation. Those eggs do not hatch because they have not been fertilized. Thus would perish every animal or vegetable germ that did not receive the vivifying impregnation. Any other explanation is impossible. Do not speak of the lateness of the laying; eggs of the same date from other mothers are perfectly fertile. Once again, they do not hatch because they have not been fertilized. "And why have they not been fertilized? Because the seminal bag, so small that it has often escaped my observation, in spite of my viligance, had exhausted

its contents. The mothers whose spermatheca preserved till the end a remnant of the fecundating element had their last eggs as fertile as the first; others with a seminal receptacle too quickly exhausted had their last laying smitten by death. This seems to me clear as daylight."

"If the unfecundated eggs perish without hatching, those that hatch and produce drones are therefore fecundated; and the German theory crumbles." "What explanation will I then give to account for the marvellous facts which I have exposed? None, absolutely none. I do not explain, I relate. From day to day, more skeptical towards explanations which may be advanced to me, more hesitating towards those that I might advance myself, I see more and more before me rising, in the black cloud of possibilities, and enormous interrogation point."

So the reason for Fabre's positive denial of the Dzierzon theory of parthenogenesis lies in the non-hatching of the last laid eggs of some of his osmia. This looks convincing. Dr. Phillips has himself written that he "found that many eggs laid by drone laying queens fail to hatch, and in fact, are often removed by the workers." But other facts rise before my mind which seem to indicate a conclusion quite different from that given by Fabre.

On page 13 of the American Bee Journal for January, 1916, I have given an experience of my young days which impressed itself vividly, because I then knew but little concerning parthenogenesis. Let me repeat the statement in part: "In my queen rearing experience it happened to us once, I believe it was in 1872 or 1873, that we found sale for seven first class Italian queens, very late in October. The amount offered for those queens, by a lover of good stock, was so enticing that we decided, my father and myself, to sell the queens, which were in very populous colonies, and take the risks of being able to replace them the same season. Queens were not then to be bought as readily as they are now. There were still many drones, as the season had been very prosperous and late.

But those queens, hatched early in November, had no opportunity to mate, for the weather turned cold suddenly and the time of their rut passed without any opportunity for flight, even though drones might have been present. The following spring we found ourselves with seven pretty and very prolific drone layers. There eggs were laid as regularly as those of fertilized queens, and their progeny hatched in the most uniform way, small drones from worker cells and large, full sized drones from drone cells. I do not remember that any of their eggs failed to hatch. True, some of them might have been removed by the bees, unknown to us, but this does not seem likely. The little drones appeared as able bodied as the large ones, and, according to the Dzierzon tests, must have been proportionally as good as the large ones. It goes without saying that we promptly replaced the queens with other breeding stock, and never did we have better early matings than that year, since thousands of drones were produced at a time when there are usually very few."

Being then between 21 and 22 years of age, I became very thoroughly impressed with this evidence of the correctness of the Dzierzon theory, which had, up to that date, appeared to me only as a possibility. I have, ever since, called it an established fact. But it is very easy to see why an observer like Fabre, who had no opportunities to make a test of this kind, should denounce the theory as entirely false. And yet it is very likely that the eggs mentioned by him as not hatching were rendered unproductive by some other cause than want of fertilization. In my experience I have seen two or three queens whose eggs did not hatch, but never had an opportunity of ascertaining the cause.

However great the genius of Fabre and his powers of observations, he was, nevertheless, subject to prejudice. Witness his antipathy to Teutonic teachings. Such an antipathy was natural in a Frenchman, writing after the crushing war 1870, but it should not have led to antici-

pated prejudice. Besides, Dzierzon, born in Karlsmarkt, eastern Silesia, may have been of Slav descent, a Pole. So even the prejudice against him might have been ill placed.

In his writings, Fabre constantly criticised Darwin and his theory of evolution, of constant change, slow and steady, due to the struggle for life and the survival of the fittest. Nothing that Fabre saw served to convince him of anything but the immutability of the habits and conditions of the minute beings which he watched so carefully, and upon which he wrote so interestingly. It would have been worth while, if he and Darwin could have been placed face to face for a few hours, and urged to discuss their views. They were both accurate naturalists and both after the truth. They were 14 years apart. Darwin was born in 1809 and Fabre in 1823. Neither took things for granted, but while Darwin tried to explain some of the phenomena which he saw, Fabre left, at the end of his studies and his wonderful descriptions, what he himself calls "an enormous interrogation point."

C. P. Dadant.

Extract from "American Bee Journal", for June, 1918, p. 192.

Laying Workers which Produce Female Offspring.

By John Anderson, M.A., B.Sc.

In Dr. Phillips' Beekeeping (1915), there are two references (pp. 187, 203) to a paper by G. W. Onions in the Agricultural Journal of South Africa for May, 1912. Mr. Onions asserted that, among Cape Black Bees, laying workers occurred very frequently and from their eggs drones, workers and queens were produced. This extraordinary claim seems to have attracted little attention at

the time except that one or two Cape beekeepers wrote refusing to believe the story. Mr. Onions, however, was not discouraged, and when he removed to Rhodesia he sought help of the Division of Entomology at Salisbury. Mr. R. P. Jack, F.E.S., undertook the superintendence and checking of fresh experiments in parthenogensis, to be carried out at Salisbury, but with bees from Cape Colony. A full account of those further experiments, conducted with scientific care, was published in June, 1917, in the Transactions of the Entomological Society of London. Mr. Jack is convinced that Mr. Onions has proved his conclusion that workers of the Cape bee "are apt to develop the habit of laying eggs, and that these eggs may produce workers, queens or drones, but do, as a matter of fact, mainly produce workers."

Dr. Phillips, Mr. Onions and Mr. Jack seem to have been unaware that the power of certain worker bees to produce female offspring was noted, and the facts published, many years before the appearance of Mr. Onions' first paper in 1912. The oversight is pardonable in the case of Phillips, Onions and Jack, because such recent writers could hardly be expected to know that valuable papers on beekeeping used to appear in the Journal of Horticulture, published at London and edited by Robert Hogg, L.L.D., F.L.S. English contributors to the Journal of Horticulture included Cheshire, Woodbury, Hewitt and the two Carrs, while among the Scottish writers were Pettigrew, Thomson, Raitt and McPhedran. Every one of these writers made additions of permanent value to our knowledge of beekeeping, though, with the exceptions of Cheshire and "W.B.C." their names are scarcely known to the present generation of British beekeepers.

John Hewitt, of Sheffield, England (and his name ought to be mentioned with those of Schirach, Huber, Dzierzon and the other great masters) made his observations on laying workers more than 30 years ago, and published a brief account of them in the journal of Horticulture for 1892 (August 11, page 134). It was perhaps

fortunate that the Journal of Horticulture was not exclusively a bee journal, and that Dr. Hogg was broad-minded enough to realize that perhaps, after all, Dzierzon had not said the last word on parthenogenesis in the bee. When Hewitt attempted to make his discovery known through the bee press of Britain and America his main conclusions were either suppressed or covered with ridicule. No discoveries might be published which would not fit into the Dzierzon theory. It is thus only by a kind of accident that we can establish priority for the original discoveres of an unsuspected peculiarity in the workers of certain races of the honeybee.

European bees, with which alone Dzierzon was familiar, have one marked defect in their otherwise perfect arrangements for preserving the continuity of the stock. At the time when a virgin queen is ready to be mated there is no other queen in the hive (except perhaps in supersedure) and there is no means of making one. The virgin is the sole hope of the stock, and if she be lost or fails to mate, that stock is doomed.

Hewitt had been working with Punic or Tunisian bees, which he had imported direct from North Africa, and found to differ greatly from the bees of Europe. For example, a stock which had lost its virgin on her mating flight, promptly developed laying workers, and raised queens from the eggs of those workers.

"In one case a number of Punic workers entered stock of queenless Carniolans and reared a queen from the eggs they laid. This queen is now in the British Museum." (1892.)

It is clear from the narrative that Hewitt had been familiar with the facts for some considerable time, and that his object was to get others to verify observations, of the accuracy of which he entertained no doubt whatever. He proceeds to give directions for inducing Punic bees to rear queens from the eggs of laying workers. The aim is to reproduce as nearly as possible the conditions of a stock that has lost its queen on her mating flight. It

must be queenless and broodless with some drones present.

"The bees will soon be busy laying and rearing queen cells. If any of these seem natural, that is not long ones, but just like ordinary queen cells, queens will most certainly be found in them, and not only so but numbers of worker bees will hatch from worker cells. Hence Punic worker bees have the power to raise both queens and drones from themselves. The instinct seems perfect in the Punic bees; only partly so in Syrians, and it is quite absent in our native bees. I cannot go into the matter just now, but should like as many as possible, who have those bees, to confirm my discovery, incredible as it may seem."

From these quotations it is quite clear that Hewitt had made the greatest discovery in the natural history of the bee since the time of Dzierzon, and that he anticipated Onions by at least 20 years. The bees of Africa are probably nearer to the ancestral stock, and the workers still retain the power of reverting to the primitive condition when every female was a potential mother. Hewitt's remark that the power is less perfectly developed in the Syrian bee and totally absent in native bees, is highly significant. Dzierzon and his co-workers, being acquainted only with the more specialized bees of Europe, had no chance of making this discovery, and made the very usual mistake of generalizing from insufficient data.

Meantime only the barest facts are mentioned, but it is evident that a new vista has been opened up, and that we must now consider parthenogenesis in the honeybee from quite a different standpoint.

Agricultural College,
Aberdeen, Scotland.

Reviews of Nat. History Publications.

"*The Ibis*, 1919.

The April issue contains a paper by one of our most active Ornithological members — Lieut. C. G. Finch-Davies, 1st S.A.M.R. "Some notes on *Hieraaetus ayresi* Gurney Sen. (Plate III.) (*H. lucani*).

This is an account of the author's re-discovery of a little-known and doubtful species Mr. Davies shows that the species is valid and publishes a list of those in the S.A. Museums, and gives us a beautiful chromo-lithograph of the bird from a painting by himself. He also details the differences between this bird and its closest ally (*H. spilogaster*.)

The Editor of the "Ibis", and one time Director of the S.A. Museum and President of the S.A.O.U., (W. L. Sclater, M.A., etc.), publishes "A note on the Buzzards of the Ethiopian Region" with a coloured plate of a new sub-species of *Buteo jakal* (*archeri*) from Somaliland. The name of the Steppe Buzzard has been changed from *Buteo desertorum* to *B. buteo rufiventer*. Mr. Sclater further considers that *Buteo oreophilus* is also found in S. Africa. This number also contains an obituary notice of the late President of the British Ornithologists Union (F. DuCane Godman) with photogravure plate.

The July issue contains a paper by Lieut. Col. R. Meinertzhagen on "a preliminary study of the relation between geographical Distribution and Migration, with special reference to the Palæarctic Region". Mr. F. E. Blaauw contributes a paper on "The plumage-development of *Nettion torquatum*, *Anas undulata* and *Poecilonetta erythrorhyncha*." The two last are South African ducks, which he has succeeded in breeding

The October No. contains part III. of the list of birds of the Anglo-Egyptian Soudan by W. L. Sclater and C. Mackworth Praed (Plate XIX). This part deals with the

Picidae to Sagittariidae, and is accompanied by a map of the region in which the birds were collected. The birds of prey are well represented; and the family and generic name of the Secretary Bird has been changed from Serpentaridae and *serpentarius* to Sagitarriidae and *sagittarius*.

The Emu.—Official organ of the Royal Australian Ornithologists Union, 1919 (4 Nos.).

The January, 1919, No. contains the account of the annual meeting held on 4 December, 1918, when Major (Dr.) W. Macgillivray, was elected President (being the tenth). The Union seems to have prospered, despite the war, and we must congratulate our Australian colleagues on a successful year. The July and October Nos. contain a fine review of the *Megapodidae* by Dr. Shufeldt, illustrated by plain and coloured plates.

Novitates Zoologicae.—Vol. XX., 1918.

The colour changes of the Beak and shield of the Young Moorhen (*Gallinula chloropus*). By Frances Pitt.

A description of the young plumage of the Moorhen, more especially that of the beak and shield—illustrated by a coloured plate

Types of Birds in the Tring Museum.—Ernest Hartert, Ph.D.

This consists of a catalogue of "A," Types in the Brehm collection; (we see that Dr. Hartert uses Mathew's suggested *Tyto* instead of the old well known generic name of *Strix* for the Barn owls). Description of new genera and species of *Amatidae*, *Lithoridae* and *Noctuidae* by Sir George P. Hampson, Bart. This valuable article describes a large number of new forms from India, Africa, Borneo, New Guinea, America, etc.

"Catalogue of the *Parnassinae* in the Tring Museum," by Lord Rotschild.

Notes on pigeons by E. Hartert and A. T. Goodson. *Inter alia* the various forms of Fruit Pigeon (*Treron*) are discussed.

A further contribution to the Ornithology of Uganda (West Elgon and District), by Dr. V. G. L. van Someron, M.B.O.U. (Plates III.-VII.). This part mentions a number of forms found in Southern Africa, especially amongst the birds of prey. The author considers the East African sub-species of *Syrnium woodfordi,* identical with the South African Bird.

Our common Diederik or Golden Cuckoo is now called *Chrysococcyx caprius* Bodd. the name of *cupreus* being relegated to the Yellow-breasted Emerald Cuckoo.

Correspondence.

Southwest Museum.
Marmion Way and Avenue 46,
Los Angeles, California.
24th September, 1919.

Dear Sir:

The Entomological Department of our Museum is desirous of effecting exchanges in diurnal Lepidoptera. We have on hand a large number of desirable West American species and a small assortment from South America, which we offer in exchange for butterflies from your district. If you are personally interested, we will be pleased to receive a representative assortment for which we will make adequate returns; or, if you prefer, we will send you a selection from our district immediately on hearing from you.

We will be pleased to have you call to the attention of other entomologists in your district this offer of exchange.

Yours very truly,
SOUTHWEST MUSEUM.
for John Comstock,
Assistant Director.

Assiniboia, Lask., Canada.
April 9th, 1919.

Dear Sirs:—

I have your name as being possibly interested in Butterflies and Moths and as I greatly desire to locate a good collector in your Country, I would be pleased if you could help me at all in this matter.

If you yourself, are interested, and collect, will you kindly advise me what you have on hand or will have later, either for Sale or Exchange, and quote me your price to dealers for named and also unnamed specimens, first quality **in papers,** at individual prices; on lots of 25 to 50 of a kind or a flat price per 100 on mixed specimens—just as you wish, bearing in mind that I will buy large numbers of all desirable species. Or if you exchange, please send either a selection for exchange to me, or a list of desiderata, and I will allow two-thirds value on things you desire.

On the other hand if you neither sell or exchange possibly you could—without too much trouble—send me the names of collectors or **Dealers** whom I could deal with.

Hoping to hear from you soon and thanking you in advance for any help you can give me, I am

Yours truly,

George G. MacBean.

Lepidopterist.

Vol. 2. No. 2. Price 7s. 6d.

THE

SOUTH AFRICAN JOURNAL

OF

NATURAL HISTORY

being the official organ of the

SOUTH AFRICAN BIOLOGICAL SOCIETY

with which is incorporated the Journal of
The South African Ornithologists' Union.

Editors:

E. M. DOIDGE, *Editor-in-Chief*

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J. HEWITT.

PUBLISHED BY
THE SOCIETY IN PRETORIA, SOUTH AFRICA
LONDON AGENTS:
WITHERBY & CO., 326 HIGH HOLBORN, W.C. 1.

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THE

SOUTH AFRICAN JOURNAL

OF

NATURAL HISTORY.

VOL. II. SEPTEMBER, 1920 NO. 2.

Biological Society,
Pretoria.

Minute from the Biological Society of South Africa to the Public Service Commission: prepared by the Delegates appointed to represent it and passed by the Council of the Society.

PREAMBLE.

Since the membership of this Society includes representatives of several branches of science, and also civil servants in many grades of employment, the Society does not wish to state a case for any single group of officers but rather to consider the conditions of employment as they may effect the whole body of scientific workers.

THE NEED FOR A SPECIAL DIVISION.

It is felt that a special Technical, Professional, and Scientific Division, should be constituted in the Civil Service, consisting of an upper and a lower branch separated by a fairly stringent examination barrier,

degree, or recognised diploma. Conditions of service as applying to such a naturally defined group of officers could then be dealt with, irrespective of circumstances peculiar to other Divisions.

It may be emphasised that an upper and a lower branch may well be instituted in a Scientific and Technical Division, even if it were regarded as undesirable in a Clerical and Administrative Division. A qualification barrier which no mere experience can surmount is essential in most professions and sciences, and is already recognised in principle.

(a) *Lower Branch.*—The lower branch should be recruited from matriculated youths who expect to receive their training wholly within the Government Departments which they enter, and any technical vacancies filled by unmatriculated youths should be grouped in a General Division and not in the suggested Technical Division.

The terms of entry and opportunities for promotion of such matriculants should be the same as those maintaining in the Clerical Division, recruited from the same matriculation level, and advancement to the point corresponding to that of a first grade clerk should be straight forward. Beyond this, meritorious cases could be dealt with individually or by "relief scale" without involving admission to the upper branch.

It may be noted that serious grievances of certain matriculated "laboratory assistants" would be rectified by removing them from the existing "General Division" and affording them opportunities for uninterrupted promotion to the status and emoluments corresponding to those of a first grade clerk. Beyond this they could not expect to go, since they are neither qualified by degree nor eligible for administrative work.

(b) *Upper Branch.* — Excluding exceptional cases which will always have to be handled in an exceptional way, a University Degree, recognised Diploma, or Special

Service Examinations, should represent the minimum entrance requirements, and passage from the lower branch to the upper branch should be conditioned by clear-cut examination qualifications.

There should be no hardship in introducing this barrier, since it need not be made retrospective for existing officers, and every youth contemplating the Service for the first time would clearly understand the conditions of his promotion.

The effect of such a "degree barrier" would be to encourage higher education in the country, support the Universities and Closed Corporations by defining a career for some of their graduates, and ensure the entrance into the Technical Service of a good stamp of man.

Within this Upper Branch the system of grading should be reduced to a minimum, and a "rank and file" scale be established which would prove attractive to the class of man drawn from the Universities.

Scales of Salaries.

This Society only proposes to concern itself with the rank and file of scientific and technical workers, and to leave aside what may be regarded as senior appointments.

(a) *Lower Branch.* — Salaries should correspond with those of the Clerical Division up to the point at which clerical officers take over semi-administrative responsibilities, and continuous promotion should therefore be assured up to about £400 or £450 per annum, irrespective of "Vacancies".

A probationary period at a salary of £120-£160 might be introduced for the sake of weeding out undesirables, but it is felt that the moment the top of the probationary scale is reached, and permanent appointment is offered either as the result of a practical examination test or on the recommendation of a senior officer, a continuous scale of about £180-£450 should come into force.

It is considered that in no other way will a matriculated youth be attracted to a class of scientific work which demands a high degree of skill and reliability, without necessarily involving an inordinate tax upon "congenital brains".

The lower probationary maximum of £160 will not tempt even the indolent to remain in the Service, while the permanent service maximum of £450 will attract the able matriculated who, for one reason or other, can not proceed with a higher education, but who nevertheless prefers technical service to an office career, or a skilled trade.

(b) *Upper Branch.*—In this branch a general grading of £400 by £25 to £500, by £33⅓ to £800 is strongly recommended. The starting point of £400 for graduates represents little more than a skilled artisan wage, and might well be made higher but for the fact that a probationary period on an intentionally unattractive salary may be desirable for a young man whose working habits of life are not yet set. It should, however, not be lower, since the Service should aim at being in the position to select the most distinguished graduates by competing with the attractions of an open career.

The probationary period of £400 by £25 to £500, should serve to eliminate undesirables, since it is not sufficiently attractive to retain even an unsuitable graduate for an indefinite period. It is thought that the "square pegs in round holes" would rapidly realise that they had selected the wrong vocation if they failed to jump the £500 barrier, and seek "technical commercial" employment more congenial to them.

The transition to £500 by £33⅓ to £800 should be made dependent upon record of work, or upon examination barrier, or upon the gaining of higher degrees, such as "Doctorate by Thesis" according to the exigencies of the section of the Public Service to which the officer belongs. This barrier, however, should on no account be dependent

upon the chance occurrence of vacancies. It is most strongly felt by this Society that promotion by Seniority and the waiting for "dead men's shoes" is fatal to contented service, and that a fully qualified scientific officer, with the social obligations of an educated man, should not be taken into the Service at all unless he can be assured of promotion on satisfactory service, to at least £800 per annum. The suggested efficiency barrier at £500 is sufficient to block indolents or incompetents, and more solid work will be given by an enthusiastic officer on £800 than can be extracted from two discontented officers on less.

Seniority.

The suggestion has been put forward by certain vigorous members that all rank and file officers should be regarded as of "equal seniority", as soon as they reach the top of their grade. The present system of treating seniority as the main credential for promotion is regarded as basically bad, and they maintain that a system in which *personal antiquity* is taken into undue consideration is subversive of the best interests of the service. They urge that the "Chamois should not be expected to climb by the mule path" and that grey hairs are not in themselves deserving of respect.

Ceteris paribus, Seniority must of course be considered, but a system by which official seniority disappears at the top of a grade has much to recommend it. Once the principle were clearly recognised there should be little heart-burning, the promotion of a younger man would no longer be regarded as a "superceding" of an older, while a direct inducement would be offered to individual energy.

Higher Degrees and Post-Graduate Experience.

It is regarded as most important that due recognition should be given to graduates entering the Service with qualifications above the "minimum entrance require-

ments" of the upper branch. As matters stand at present a B.Sc., involving three to four years, and M.Sc., five years, and a double degree such as B.Sc., Ph. D., demanding six to seven years university training, are frequently treated alike. This is directly antagonistic to advanced scientific training, since it encourages a man to enter the service on the lowest entrance qualifications rather than upon the higest he can take. By so doing he commences his earning life sooner, acquires seniority, and puts himself into line for quicker promotion.

This Society therefore wishes to urge that at least one year's seniority, and increment of salary, be accorded for each academic year, or unremunerated year spent in acquiring special experience outside of the Service, beyond the minimum entrance requirements in vogue at any time.

Such a procdure would in almost all cases be covered by increments within the probationary period of £400-£500, since a student career of more than seven years is exceptional and would have to be dealt with in individual fashion.

Recognition of this principle would undoubtedly encourage post-graduate study and research, bring in more mature officers, and gradually raise the standard of qualifications and outside experience possessed by entrants to the upper branch of the Division.

Branch of Science Practised by Officers.

The grading suggested should be uniform throughout the Service. One adequate scale should be made to cover all sciences and professions, and no "Distinction of Cloth" should be officially recognised. Where one science is regarded as of greater economic importance than another, or productive of more tangible easily realised returns, the obvious thing to do is to increase the size of the staff, including the number of senior appointments above £800, but not to differentiate on a system of "grading by subject".

It may be mentioned that the present system of grading officers at the Schools of Agriculture on £300-£400, and officers in certain other branches of the Department of Agriculture on £380-£550, irrespective of academic qualifications or severity of training, has been the cause of intense bitterness even amongst members of our own Society. This feeling of injustice is strongest amongst the South African Government scholars sent overseas to train, who leave with ideals of a scientific career in which personal predilections can be harmonised with the problem of the loaves and fishes, but who return to find that their salaries in the Service vary with the subject they were sent away to study, rather than with the excellence of their qualifications, and the strenuousness of their training. The bad blood in the matter arises not only from considerations of varying financial reward, but from the fact that status, dignity and public respect for particular sciences, tend to follow financial grading in the Civil Service.

The case is eminently one for the future, and may be pointed by referring to the twelve scholars sent oversea by the Government this year. Of these twelve, four already hold science degrees and on return will have had a college training of from six to seven years. Under prevailing conditions, however, it happens that these four would be graded lower than four others who proceed oversea on simple matriculation, return with only a four years' student course, but have had the good luck to be appointed to a different subject.

It must be remembered that a Man's market value in the Government Service is quite different to his market value in the Industries, and that a permanent Civil Service should not be ruled by temporary fluctuations in supply and demand of particular groups of scientific workers. Thus amongst the scholars referred to, it may happen that the student specialising in "Soil Bacteriology" may prove more useful to the Government than one

of the students taking up "Tobacco and Cotton", although the latter has much better opportunity of being ultimately bought out of the Service by some private company.

This Society therefore expresses its opinion that one liberal grading should be made to cover all subjects, and that where urgency of sudden demand for a particular subject arises, a temporary shortage of men should be met by importations a few notches up a standard scale, but not appointment on a higher scale. The feeling of bitterness appears to arise from a difference in the maximum of the scale offered, and the difference in the prospects of rank and file in different sciences, rather than from minor differences in initial salary. Officers in the same grade would at least feel that they had equal status, irrespective of the "notch" on which they enter.

Oversea Scholarship System.

This Society includes a number of South Africans sent oversea to train on Government Scholarships, and these members express certain grievances peculiar to themselves.

Although the scholarship system is regarded as an excellent scheme for obtaining carefully selected recruits S. Africans by birth and bilingual by education, grave dissatisfaction is expressed with the "contract clause". Most scholars aver that this is being consciously used by the Government to get cheap "indentured labour", and to screw down to emoluments attached to scientific and technical posts. Thus certain appointments were formerly graded at £350-£450, and £450-£600, but on the return of the first batch of Government Scholars these were reduced to £285-£400 and £380-£540 respectively. To some extent this change is wrapped up in the mysterious changes brought about at the time of Union, but scholars aver that they have not been treated in terms

of the legitimate expectations prevailing at the time they went away.

They further complain that they have no redress since they are under contract to serve for a number of years, and that although there is the loop-hole for breaking the contract by refunding the scholarship money, it is not always easy to raise the necessary lump sum. Relatives who were willing to finance them by instalments during a student career, are now less able or less ready to supply a lump sum merely to enable them to break an unfair contract. They therefore have to "grin and bear it" but do so in a spirit of dissatisfaction which is not conducive to good work. The more hardy spirits then deliberately utilise the contract period merely to gain scientific experience, and resign as soon as they can afford it, just at a time they are becoming most useful to the Government. The weaker spirits tend to give the Government that indolent minimum of service to which they consider their salary corresponds.

The view of the scholarship group of our Society is that they are treated as "Charity Boys". They urge that no differentiation should be made in the starting point for Government Scholars and open marker importations of the same standing. The latter, they urge, gain not only in immediate emoluments, but in seniority, status and opportunity for promotion, to the lasting disadvantage of the South African Scholars.

They feel that the Government Scholarships should be freed from the contract clause, and as in the case of University Scholarships be offered as prizes in specified subjects. They maintain that by adjusting the number of such scholarships the Government would get all the recruits it requires, and that since every S. African naturally wishes to return to his own country, the contract clause is unnecessary provided the salaries offered on return are reasonably attractive.

If, however, the contract system be maintained, and the Government insists upon getting its money back, they urge that a fairer method would be to demand cash repayment by "deductions on the pay sheet" over a period of years, rather than to reduce the grade of appointment with consequent reduction in prospects.

Pension Service.

The later an officer enters the service the lower is the final value of his pension. It is therefore considered desirable that the upper branch of the suggested Scientific and Technical Division should have the option of contribution to the Pension Fund on the basis of 5% of salary instead of the usual 4%.

It is maintained, however, that a still greater improvement in the Pension Privileges could be effected by revising the whole scheme, on an actuarial basis, in such a way as to incorporate provision for widows and minor children. Our body is termed the Biological Society, and it is in no humorous spirit that it alludes to the propagation of the human species. An officer on a low salary, and a pension which terminates with his own life, is apt to consider marriage, and particularly the artificial sterilisation thereof, in a cold spirit of biological enquiry not altogether advantageous to the birth-rate. It is urged, therefore, that the present pension scheme is defective from the point of view of "life insurance", and that it could be vastly improved by embodying the principle of an optional "joint annuity" for husband and wife.

Leave Privileges.

Science may be regarded as differing from clerical and administrative work in the sense that in certain subjects a "scientific error" may pass undetected much longer than a clerical or administrative mistake, and that, in Research, progress is often made by sudden leaps on the

part of the individual directly engaged upon the work. There is a great tendency towards individual responsibility, and the scientific officer, if he is to be effective, must be thoroughly up-to-date in his particular subject. He should, therefore, not be allowed to degenerate into an executive officer of any system in which he finds himself, but should periodically be afforded an opportunity of coming into contact with Institutions in the great scientific centres of the world. This is particularly necessary in the case of officers employed in special subjects in Government Divisions of which they are more or less isolated units. It is therefore urged that provision should be made to introduce the American principle of "Sabbatical Leave" for officers of the upper branch of the Scientific and Technical Division, and that opportunity be allowed to such officers to devote one year in seven to advanced study in connection with their official work. It may be pointed out that opportunity for extension of the ordinary 6 months "cumulative leave" to 12 months, is necessary, in order to allow of continuous work throughout an organised academic year, and at the same time allow the officer to enjoy the ordinary recuperative leave during the academic vacations.

Such a scheme would not involve any serious cost to the Government, since the period spent in advanced study would have to be certified by the oversea institution as being of definite value to the officer in connection with his official work, and should properly be regarded as "duty" rather than "leave". Abuse of the privilege could easily be controlled by insistence upon Departmental sanction of the particular locus of study, and since human nature is what it is, only enthusiastic officers would ever take advantage of the privilege.

In this connection it might be argued that six months additional leave without pay, would meet the case, and that the recompense for such privately undertaken study

would be found in enhanced chance of future promotion. Against this, however, it is contended that some of the most meritorious and enthusiastic officers would be financially unable to take "leave without pay"; that "study leave" should be encouraged for its own sake and its beneficial influence upon the service as a whole; that the opportunity for promotion is limited, and that far more officers should be encouraged in post-graduate study than there are prospective vacancies for promotion.

Recognition of Special Merit.

It is felt that for scientific work some system of recognition for special merit should be recommended by the Commission. Inherent in the nature of science is the fact that an individual may do work of high value to the country, but yet that it may be work which does not count for promotion in the ordinary sense. In promotion to appointments such as "Divisional Chief" it is often necessary to take into consideration qualities of personality, social prestige, and administrative capacity, besides those of scientific acumen and originality in research. Furthermore, an officer whose experience is wide and diffused has a better chance than one whose experience is specialised and deep. Many a fine scientific mind, tabernacled within a nervous apologetic exterior, or concentrated along a highly specialised line of work, may go unrewarded. It is felt therefore, that personal recognition should be arranged for by a system of purely personal promotion beyond the orthodox grade, irrespective of the occurrence of senior vacancies. Such direct personal recognition would act as a powerful spur to intensive work, and a cheerful disregard of official hours of Civil Service Labour.

A second method has much to recommend it, and which need not conflict with the principle of personal increment of salary, is the "Bonus system". This principle has already been indirectly recognised in this country. When,

over a year ago, a foundation member of this Society and Director of an important scientific Division, was awarded a bonus of £3,000 by Parliament, in special recognition of his scientific services to the country, both his own staff and his fellow biologists of this Society felt that in honouring him the Government had honoured them.

It may be recalled that large private corporations also recognise the principle, as in the case of the recent bonus to Dr. Lister in Johannesburg, and that Sir Ronald Ross is leading a strong movement in Britain for direct admission of the custom of granting Government bonus to distinguished scientific workers.

Individual Grievances.

The question of permanent machinery for redressing individual grievances is, though taken last, regarded as one of the most important matters with which the Commission has to deal. It is maintained that equity of treatment is of even more importance than magnitude of salary, and much bitterness exists because of personal grievances. The feeling is all the stronger when it is recognised that all such inequities could be wiped out at trifling cost, if cases could be referred to a sane tribunal of impartial minds. The general contentment of a Service is much affected by a few known cases of injustice, and it is therefore urged that the Commission should recommend the establishment of a permanent body to whom civil servants would be entitled to present an individual grievance, or a group grievance, and learn the case against them.

Such a body might well be a reorganised "Permanent Public Service Commission," small in number but powerful in status, independent of departmental influence, and directly responsible only to Parliament.

Darwin, Before and After.

By H. B. Fantham, M.A. Cantab, D.Sc. Lond.,
Professor of Zoology, University College, Johannesburg.

(Public Lecture delivered before the S.A. Biological Society, in the Town Hall, Pretoria, on 19th March, 1920).

"The old order changeth, yielding place to new." So wrote Tennyson, and such the vast majority of mankind believes to be the case. Yet it is far too often overlooked that it is from the ashes of the past that there arises the new life of the present, and that without the experiences of the past, present-day conditions could not obtain. In the world of Nature change is not violent. There is a gradual transition, sometimes by almost imperceptible degrees, between the old and the new. The vast mass of biological facts available at the present day are only available because of the labours of the earlier workers, who, almost without guidance, wrestled with Nature and wrung from her the secrets on which modern science is based. It was not by means of subtle speculations and subtler sophistries that such knowledge was won, nor was it obtained by argumentative criticism of the work of others, nor by the superimposing of individual fancies and opinions upon others. But it was by direct, searching investigation and experiment, careful observation and correlation of even minutest details and clear, logical inferences from the data thus obtained that Truth was made to issue from her well, and appear in all her beauty for the information of the world. Among those earnest seekers after truth regarding living things, there is hardly one who has made so profound an impression

on the minds of the masses as Charles Darwin, the pioneer interpreter of the varied phenomena collectively termed Evolution.

Not only was Darwin's work interpretative in the field of strict biological science—zoology, botany and geology—but it touched upon and illuminated almost every form of human thought. As illustrations, may be mentioned the great influence of Darwin on the study of embryology, the development from the point of view of psychology of the ideas of mental factors in evolution, the influence of the conception of evolution on modern philosophy, religious thought and study, history and sociology. The subject is vast and would require many lectures; it is my intention to indicate some of these aspects of the influence of Darwin, as well as to deal with a few of the rather more familiar ones, and I hope thereby to arouse a spirit of more searching analysis and clearer thinking than is expressed in the almost only current opinion regarding Darwin, namely, that he is, but wrongly, reputed to have said that man arose from monkeys. His real opinion was that man and monkey had a common ancestor.

Among some of the Greek philosophers, Nature was considered to have developed, and still to be undergoing a process of change. Aristotle, who was the founder of comparative anatomy, recognised the unity of plan prevailing throughout each of the great groups of animals. Biology made little progress during the Middle Ages, and it was not until the 18th century that a glimmering idea of evolution or the doctrine of descent came into being. Buffon (1707-1788) and Erasmus Darwin (1731-1802), the grandfather of Charles Darwin, clearly stated that species had not been created independently, but had originated from pre-existing species. However, the greatest of the pre-Darwinian evolutionists was Lamarck (1744-1819), and Haeckel described his "Philosophie zoologique" (1809) as "the first connected and thoroughly logical exposition of the theory of descent."

The main hypothesis of the famous French biologist, Lamarck, was the cumulative transmission of functional modifications. For example, the long neck of the giraffe was supposed to have been gradually developed in response to the need of the animal to browse on the leaves of trees, and of constant effort in order to reach such foliage. As a result, not only did the neck become long, but the forelimbs also became longer than the hind limbs. Again, the disuse of their eyes by cave animals brought about a dwindling and subsequent degeneration of these organs. Such modifications or acquired characters, more correctly termed acquired changes or variations, were supposed by Lamarck to be transmissible to the offspring. In other words, by the inherited effects of use and disuse, and of modifications caused by external conditions, Lamarck supposed all evolution of species to have come about. At this stage, it may be remarked that the most able modern defender of the principle of use-inheritance was Herbert Spencer. Darwin himself admitted the minor importance of the inheritance of acquired characters.

Much more might be written of Lamarck's ideas, derived from his studies of botany and zoology. These ideas embody three truths: first, the certainty that species vary under changing external influences; second, that there is a fundamental unity in the animal kingdom; third, that there is a progressive and perfecting development. "Nature," he writes, "to perfect and to diversify animals requires merely matter, space, and time." ...... "For Nature," he continues, "time is nothing." While time limits demand that we turn to the central figure in the hypothesis of evolution, it must not be forgotten that the work of Lamarck was highly important, and that its value has been recognised and utilised very largely in present-day zoological philosopy, particularly in America, where the Neo-Lamarckian school of biologists has done much valuable research. We now pass to a

review of the chief events in the life of CHARLES DARWIN.

He was born at Shrewsbury, February 12th, 1809. In 1825 he was sent to Edinburgh University for two years. In 1828, he commenced residence at Christ's College, Cambridge, and soon came under the influence of the famous botanist Professor Henslow, and later under the influence of the geologist, Prof. Sedgwick. He passed the examination for the B.A. degree in January, 1831. On December 27th of that year he began his voyage in H.M.S. Beagle, a barque of 235 tons carrying 6 guns, under Captain FitzRoy, sent by the British Government to survey the southern parts of South America. He was away five years and returned to Shrewsbury for a short time and to Cambridge in 1836. In 1837 he began to prepare his journal for publication, and then saw how many facts indicated the common descent of species. He writes: "In July, 1837, I opened my first note-book for facts in relation to the origin of species, about which I had long reflected, and never ceased working for the next twenty years." He had been greatly impressed by the character of South American fossils, and species on the Galapagos Inlands. About this time he went to live in London, and in 1838 he "happened to read for amusement Malthus on Population, and being well prepared to appreciate the struggle for existence which everywhere goes on from long-continued observation of the habits of animals and plants, it at once struck me that under these circumstances favourable variations would tend to be preserved, and unfavourable ones to be destroyed. The result of this would be the formation of new species. Here then I had at last got a theory by which to work; but I was so anxious to avoid prejudice, that I determined not for some time to write even the briefest sketch of it." In 1839 he married his first cousin Miss Emma Wedgwood, daughter of Josiah Wedgwood. In 1842 he settled in the village of Down in Kent, and published

his well known work on Coral Reefs. In 1851, he published a monograph of the fossil Lepadidae (barnacles). In 1856, Sir Charles Lyell advised him to write out more fully his views on the origin of species. In 1858, a joint paper by Charles Darwin and Alfred Russel Wallace was read before the Linnean Society of London. On November 24th, 1859, was published his famous work "On the Origin of Species by means of Natural Selection, or the Preservation of Favoured Races in the Struggle for Life." This rapidly passed through a second and third edition. In 1862, he published his book on the "Fertilisation of Orchids by Insects." In 1868, he published a work on the "Variation of Animals and Plants under Domestication." In 1871, was published his famous work on the "Descent of Man." In 1875, he produced his work on "Insectivorous Plants." In 1876, he wrote an autobiographical sketch which was continued in 1881. Among his later publications were "The effects of Cross and Self Fertilisation," "The Different Forms of Flowers on Plants of the Same Species," "The Power of Movement in Plants," and "The Formation of Vegetable Mould through the Action of Worms." Charles Darwin died at Down on April 19th, 1882, and was buried in Westminster Abbey, near the grave of Sir Isaac Newton. The modesty of the man was shown by his own words: "As for myself, I believe that I have acted rightly in steadily following and devoting my life to Science. I feel no remorse from having committed any great sin, but have often and often regretted that I have not done more direct good to my fellow creatures."

As illustrative of Darwin's modes of observation and investigation, we may consider a few examples provided in his works:— For instance, Darwin observed very carefully the transformations undergone by the various domestic races under the influence of artificial selection. His attention was drawn to a group of animals lending themselves peculiarly well to such observation, namely,

domestic pigeons. There are many races and varieties, which differ in shape, colour, size and instincts. For example, there are the carrier pigeons, with their special topographical instinct; the tumblers, which are in the habit of flying at a great height in compact flocks, and then tumbling in the air head over heels; the fantails, whose tail, owing to the disposition of its feathers, resembles that of a peacock; others have tufts of feathers, peculiar creases of the skin, modified beaks or feet, or other marked features. Darwin secured specimens of every available breed from all parts of the world. He became acquainted with the best known breeders and fanciers, joined two London pigeon clubs, and after years of observation, succeeded in proving that all the various breeds were descended from one single species, the European rock pigeon, *Columba livia*. Previously, breeders had believed the different varieties to be derived from as many wild species.

Again, Darwin discussed the breeding of the elephant. The elephant is considered to be the slowest breeder known. Yet if one elephant produces six young, then after a period of 750 years, there would be about nineteen million elephants alive, all descended from the first pair. If all species of animals increased at the same ratio, their numbers would become so inordinately great that no country could support them.

In 1858 he wrote:— "Even slow-breeding mankind has doubled in twenty-five years; and if he could increase his food with greater ease, he would double in less time. But for animals without artificial means, the amount of food for each species must, *on an average*, be constant, whereas the increase of all organisms tends to be geometrical, and in a vast majority of cases at an enormous ratio. Suppose in a certain spot there are eight pairs of birds, and that *only* four pairs of them annually (including double hatches) rear only four young, and that these go on rearing their young at the same rate, then

at the end of seven years (a short life, excluding violent deaths, for any bird) there will be 2048 birds, instead of the original sixteen. As this increase is quite impossible, we must conclude either that birds do not rear nearly half their young, or that the average life of a bird is, from accident, not nearly seven years. Both checks probably occur. The same kind of calculation applied to all plants and animals affords results more or less striking, but in very few instances more striking than in man."

"In nature we have some *slight* variation occasionally in all parts; and I think it can be shown that changed conditions of existence is the main cause of the child not exactly resembling its parents; and in nature geology shows us what changes have taken place, and are taking place. We have almost unlimited time."

However, the increase of living animals depends on very many and diverse conditions. Thus, Darwin discusses the case of a barren heath planted with Scotch fir. The change in the native vegetation of the planted part of the heath was most remarkable, greater than that generally seen in passing from one soil to a quite different one. Twelve species of plants flourished in the plantations which could not be found on the heath. The effect on the insects must have been still greater, for six insectivorous birds were very common in the plantation, which were not found on the heath.

Again, fertilisation of certain plants can only be effected by definite insects. Thus, the visits of bees are necessary for the fertilisation of clover. The reproduction of red clover, however, is dependent on humble bees. The number of humble bees depends in a great measure upon the number of field-mice which destroy their nests, and the number of mice is dependent on the number of cats. Thus the number of cats in a district might determine the frequency of red clover in that district.

In 1858 he wrote: "Another principle, which may be called the principle of divergence, plays, I believe, an

important part in the origin of species. The same spot will support more life if occupied by very diverse forms. We see this in the many generic forms in a square yard of turf, and in the plants or insects on any little uniform islet, belonging almost invariably to as many genera and families as species...... Now, every organic being, by propagating so rapidly, may be said to be striving its utmost to increase in numbers. So it will be with the offspring of any species after it has become diversified into varieties, or subspecies, or true species. And it follows, I think, from the foregoing facts, that the varying offspring of each species will try (only few will succeed) to seize on as many and as diverse places in the economy of nature as possible. Each new variety or species, when formed, will generally take the place of, and thus exterminate its less well-fitted parent. This I believe to be the origin of the classification and affinities of organic beings at all times, for organic beings always *seem* to branch and sub-branch like the limbs of a tree from a common trunk, the flourishing and diverging twigs destroying the less vigorous—the dead and lost branches rudely representing extinct genera and families."

Again, in 1872, Darwin stated: "If under changing conditions of life organic beings present individual differences in almost every part of their structure, and this cannot be disputed; if there be, owing to their geometrical rate of increase, a severe struggle for life at some age, season, or year, and this certainly cannot be disputed; then, considering the infinite complexity of the relations of all organic beings to each other and to their conditions of life, causing an infinite diversity in structure, constitution, and habits, to be advantageous to them, it would be a most extraordinary fact if no variations had ever occurred useful to each being's own welfare, in the same manner as so many variations have occurred useful to man. But if variations useful to any organic being ever

do occur, assuredly individuals thus characterised will have the best chance of being preserved in the struggle for life; and from the strong principle of inheritance, these will tend to produce offspring similarly characterized. This principle of preservation or the survival of the fittest, I have called Natural Selection. It leads to the improvement of each creature in relation to its organic and inorganic conditions of life, and, consequently, in most cases, to what must be regarded as an advance in organisation. Nevertheless, low and simple forms will long endure, if well fitted for their simple conditions of life.

We may now attempt to summarise Darwin's work in general terms. *Evolution* or the doctrine of descent may be briefly defined as progress involving differentiation, or as the alteration of the average characters, either of the whole of a species or of groups of its members, from generation to generation in a constant manner, the result being that they are so different from what they were before, that a new species arises. The said species has, however, its own definite characters, and the test of validity of a species is that it breeds true, the offspring not reverting to the marked characters of the ancestral stocks, but retaining the modified characteristics that are the result of the differentiation from those ancient features.

Evolution implies (a) raw materials in the form of variations; (b) an arrangement for securing the inheritance of some of these; and (c) a directive mechanism for securing consistency and effectiveness of racial change.

Heredity, here referred to, means the transference of similar characters from one generation of organisms to another, a process effected by means of the germ-cells.

As regards *Variations*, the existence of variations is an observed fact, for individuals of the same parentage are not identical. These variations may be small, fluctuating and continuous, or large, sudden and discontinuous.

Natural Selection was the process suggested by Darwin to account for the origin of new species, by the preservation or survival of the fittest variations.

Charles Darwin attached much importance to two factors, namely, the existence of small, fluctuating variations,—referred to previously, and the occurrence of a struggle for existence between organisms, owing to the natural increase in numbers and the resulting possible lessening of the food supply. The possessors of the fitter variations tended to survive. If this was kept up consistently, then by new adaptations, and probably with the help of some form of isolation, new species arose. The strength of the hypothesis of Natural Selection lies in its interpretative value. Darwin's hypothesis, supported by Alfred Russel Wallace (1823-1913), was championed by Huxley (1825-1895) and by Haeckel (1834-1919). Haeckel laid much stress on the recapitulation hypothesis, or biogenetic law as he termed it. Unfortunately, the terms evolution and natural selection have been confused under the term Darwinism. Evolution, as has already been stated, is a mode of organic progress, while natural selection is only a hypothesis, providing a reasonable suggestion as to how evolution may come about. The phrase "Struggle for existence" was used by Darwin in a metaphorical sense, for in the first edition of his "Origin of Species" he wrote: "I should premise that I use the term "struggle for existence" in a large and metaphorical sense, including the dependence of one being on another."

Darwin towards the end of his life was much more favourably disposed towards the opinions of Lamarck than he had been earlier. Thus, in the sixth edition of his "Origin of Species," regarding modification of species, he wrote: "This has been effected chiefly through the natural selection of numerous, successive, slight, favourable variations; aided in an important manner by the inherited effects of the use and disuse of parts; and in

an unimportant manner—that is, in relation to adaptive structures, whether past or present—by the direct action of external conditions, and by variations which seem to us in our ignorance to arise spontaneously." This passage also illustrates Darwin's wonderful breadth of view and absence of dogmatism. In it we see that Darwin allowed not only for the Lamarckian methods of modification, but also for the methods emphasised later in the mutation theory.

It may be interesting to compare briefly the later views of Darwin and Wallace. Unlike Darwin, Wallace conserved his earlier views entire, and remained a rigid natural selectionist, adopting an uncompromising attitude towards Lamarckism. Later, he developed a view that the whole of the organic world had been designed by a First Cause for the ultimate reception of and benefit of mankind.

Many of the Neo-Darwinians, unfortunately, followed a view which has proved to be too narrow, in that they made natural selection the exclusive factor in evolution. Chief among these was August Weismann (1834-1914), who, according to Delage, over-emphasised innate characters as against acquired characters, and predetermination as against environmental action. Weismann propounded a hypothesis of heredity based on what he termed the "Continuity of the Germ Plasm." He accepted an older hypothesis that there were two kinds of protoplasm, namely, a cytoplasm, which can assimilate and grow, and an hereditary substance which he identified with the chromatin of the nucleus. He assumed the continuity of parent and offspring through the germ cells. The germ cells are early separated from the body cells, as can be ascertained by embryological investigations. The germ cells are supposed to retain each a complete sample of the ancestral germ plasm, and so to be directly continuous from generation to generation, thus transmitting hereditary characters. Weismann's hypothesis involves

the assumption of great complexity of structure of the germ plasm, which, as already stated, he identified with the chromatin substance of the nucleus of the germ cells. In other words, inherited characters were supposed to be transmitted from germ cell to germ cell, and not through the body cells, thus denying the transmission of so-called acquired characters. According to Weismann, an organism can only inherit such characters as were inborn in the parent, and every individual contains in its sexual cells some germ plasm not only of its parents, but of its grandparents and of all its ancestors. Weismann's views are set forth in his books, "The Germ Plasm: a theory of Heredity," translated in 1893, and his "Evolution Theory," published in 1902 and translated into English in 1904.

The work of Mendel (1822-1884) sheds important light on problems of heredity from another point of view, namely, that of hybridisation. His classical paper on "Experiments in Plant Hybridisation" was published in Brünn in 1865, but was overlooked until about 1900. Mendel worked chiefly on crossing different varieties of the garden pea, *Pisum sativum*. He found that of certain contrasted couples of parental characters, which did not blend, one was dominant over the other, which was latent or recessive. The first generation of hybrids was apparently all dominant, but it was subsequently found that they were really impure dominants. When these hybrids were inbred, it was found that one-quarter of them reverted to the dominant type, one-quarter to the recessive type, while one-half reproduced hybrid features, and that these proportions were maintained when the impure dominants were again inbred. The inbred offspring of pure dominants and pure recessives bred true.

Mendel's results indicate that small individual characters may occur separately in the germ cells, and may be transmitted separately to the offspring. The individual organism may, perhaps, be composed of a number of

factors or unit characters, with regard to which there is a complete segregation among the germ cells, each of which bears one only of each pair of contrasted characters. A table of some of the dominant and recessive characters of plants and animals was shown,—for example, tall and dwarf stems in peas, yellow and green cotyledons in peas, round and wrinkled seeds in peas, susceptibility and immunity to rust in wheat, rose comb and single comb in fowls, eye-colour in man, certain diseases in man (such as brachydactyly, night-blindness, colour-blindness, haemophilia, and pre-senile cataract). Bateson, Punnett and Biffen have done much work on the elucidation and practical application of Mendelian principles in England.

New varieties may arise by crossing, and some species may have arisen in that manner, according to Lotsy.

A mode of origin of species, derived from his study of variations, was set forth by Professor Hugo de Vries, of Amsterdam, in his work entitled "The Mutation Theory," published in 1900. His conclusions were based upon the study of plants, the classical example being his work on the evening primrose, *Oenothera lamarckiana*. From his observations, he concluded that species arise from one another by changes of considerable magnitude, accomplished by discontinuous leaps and bounds. De Vries' own statement was that "the new species appears all at once; it originates from the parent species without any visible preparation, and without any obvious series of transitional forms." Further, these species are constant from the first. The discontinuous variations or mutations of de Vries are, in the main, the outward manifestations of the presence or absence of the corresponding Mendelian factors. Indeed, Mendel's experiments demonstrated the existence of discontinuous variations.

A *Hormone* hypothesis of heredity has been set forth by Cunningham and others. A hormone is an internal secretion or chemical messenger produced by some organ

or tissue, such as the reproductive organs, the pancreas, the thyroid gland and actively growing tissues. Hormones "are produced in one organ, and carried by the blood to another organ, on which their effect is manifested." According to Cunningham, external stimulation may affect certain hormones, and they, in turn, may influence the gonads, producing modifications of the corresponding parts of the offspring. Support is said to be given to the hormone hypothesis by observations on secondary sexual characters in animals, though Geoffrey Smith interpreted such characters otherwise. The development of antlers in the male deer would be the result of a chemical stimulus originating in the male organs, which, by acting on the skull, causes the inherited tendency to the development of antlers to become active. An example of the disturbance of hormones is afforded by the cretin, whose thyroid gland is diseased, and to whom the administration of thyroid extract, containing thyroid hormones to supply the deficiency, causes an increase in mental and physical development. The hormone hypothesis affords an explanation of the Lamarckian principle of the inheritance of acquired characters. Perhaps may be mentioned here the recent, interesting experiments of Julian Huxley, who induced metamorphosis of the Mexican larval Amphibian, known as the Axolotl, by the use of thyroid extract. Further experiments and explanations on this subject are awaited.

Sir Francis Galton formulated a hypothesis of ancestral inheritance. With Weismann, he assumed the continuity of the germ plasm, and figured mathematically the amount contributed by each generation to the make-up of one given individual. In other words, by statistical methods he estimated quantitatively the characters in a number of successive generations. A near ancestor bequeathed to the individual more elements than a remote ancestor. The series has been slightly modified by Professor Karl Pearson, and there has been much statistical

research in this branch of knowledge termed biometry. However, Galton's law merely expresses the *average* results which may be anticipated from the interbreeding of a large population, in which hybridisation probably plays a very small part, and so it is not necessarily contradictory of Mendelian results. In the words of Professor Karl Pearson: "It is the heavy weight of this mediocre ancestry which causes the son of an exceptional father to regress towards the general population mean; it is the balance of this sturdy commonplaceness which enables the son of a degenerate father to escape the whole burden of the paternal ill. Among mankind we trust largely for our exceptional men to extreme variations occurring among the commonplace, but .... if we could remove the drag of the mediocre element in ancestry, were it only for a few generations, we should sensibly eliminate regression or create a stock of exceptional men."

That regression can occur in Nature is shown, for example, in the development of Ascidians or sea-squirts.

Mechanistic theories of evolution have been put forward. Of these we may briefly notice a few of the conceptions of bio-mechanics. W. Roux considers the tissues and cells of the concrete organism. He is essentially concerned with embryology, as is also O. Hertwig. They attribute differentiation of the organism to the mutual attraction of the cells of the early embryo. Herbst attributes these attractions to chemical action. Roux thinks that there is a struggle between the parts of the organism for the economic use of food and space. He states that many structures are due to functional stimulation. Roux's hypothesis is one of heredity, and he recognises the inheritance of acquired characters. The famous experimental physiologist, Jacques Loeb, has similar views, and considers that the problem of fertilisation is really physico-chemical in nature, the development of the egg being regarded as a chemical process which depends mainly on oxidation.

Following as an addendum to the ideas of the action of stimulus on the organism, we may mention R. Semon's "Die Mneme" (1904). He considers that such stimulative action leaves a more or less permanent trace of such a nature as to modify the subsequent action of the organism. Others have regarded memory as a function of all organised matter. A very good treatment of the subject of memory and heredity is given by E. Rignano (1906), who accepts the transmissibility of acquired characters, relying on what he calls "specific nervous accumulators" to explain experimental embryology.

With views somewhat allied to these, we may note the materialistic vitalism of Driesch, derived from studies on embryology and regeneration, and the profound intuitionalism of Bergson.

A large number of other contributors to the theory of evolution—many of them only speculative—might be mentioned. Thus, Spencer and Romanes have made most interesting contributions to the subject, but time does not permit of details.

Summarising, we may state that of the various hypotheses put forward to account for the method of the origin of specific differences, the most important are four in number, namely, those of Lamarck and Darwin, the Mutation hypothesis and the Hormone hypothesis, and I hope that I have indicated that these hypotheses are not antagonistic to each other, but rather that they explain different aspects of this wide and complicated problem, forming complements to each other.

Again, we may briefly consider the influence of Darwin in some spheres other than those of strict biology. As Huxley wrote in 1885: "Whatever be the ultimate verdict of posterity upon this or that opinion which Mr. Darwin has propounded; whatever adumbration or anticipations of his doctrines may be found in the writings of his predecessors; the broad fact remains that, since the publication and by reason of the publication of "The Origin of

Species" the fundamental conceptions and the aims of the students of living Nature have been completely changed...... But the impulse thus given to scientific thought rapidly spread beyond the ordinarily recognised limits of Biology. Psychology, Ethics, Cosmology were stirred to their foundations, and "The Origin of Species" proved itself to be the fixed point which the general doctrine needed in order to move the world." In this connection, I would like to refer you to the Darwin Centenary Memorial volume, published under the title of "Darwin and Modern Science," by the Cambridge University Press in 1909.

Thus, Professor Höffding writes, regarding the influence of Darwin on philosophy:— "The theory of evolution has influenced philosophy in a variety of forms. It has made idealistic thinkers revise their relation to the real world; it has led positivistic thinkers to find a closer connection between the facts on which they based their views; it has made us all open our eyes for new possibilities to arise through the prima facie inexplicable "spontaneous" variations which are the condition of all evolution. This last point is one of peculiar interest. Deeper than speculative philosophy and mechanical science saw in the days of their triumph, we catch sight of new streams, whose sources and laws we have still to discover. Most sharply does this appear in the theory of mutation, which is only a stronger accentuation of a main point in Darwinism. It is interesting to see that an analogous problem comes into the foreground in physics through the discovery of radio-active phenomena, and in psychology through the assumption of psychical new formations (as held by Boutroux, William James and Bergson). From this side, Darwin's ideas, as well as the analogous ideas in other domains, incite us to a renewed examination of our first principles, their rationality and their value. On the other hand, his theory of the struggle for existence challenges us to examine the

conditions and discuss the outlook as to the persistence of human life and society and of the values that belong to them. It is not enough to hope (or fear?) the rising of new forms; we have also to investigate the possibility of upholding the forms and ideals which have hitherto been the bases of human life. Darwin has here given his age the most earnest and most impressive lesson."

Darwin's influence on religious thought is discussed by the Rev. P. N. Waggett in a most suggestive article, in which he points out that he believes Darwin's doctrine to be in the long run wholly beneficial to religious thought, for it encouraged in theology the evolutionary method of study, which has shaped all modern research.

"The influence of Darwinism on the study of Religion" is discussed by Dr. Jane Ellen Harrison, who writes:—"The study of primitive religions has been made possible and even inevitable by the theory of Evolution."

"Evolution and the Science of Language" is contributed by Dr. P. Giles, who remarks that "Darwin's own views on language which are set forth most fully in "The Descent of Man" are characterised by great modesty and caution."

"Darwinism and History" is discussed by Professor Bury, who states that "The men engaged in special historical researches .... have for the most part, worked on the assumptions of genetic history, or at least followed in the footsteps of those who fully grasped the genetic point of view."

Dr. Loeb contributes a most interesting article on "The Experimental Study of the Influence of Environment on Animals," wherein he states that "Each species has, probably, its own specific nuclein or nuclear material."

Valuable biological articles are contributed therein by Professors J. A. Thomson, A. W. Weismann, H. de Vries, W. Bateson, E. Strasburger, E. Haeckel, A. Sedgwick, D. H. Scott, E. B. Poulton, C. L. Morgan and Sir Francis Darwin.

Of these latter, I would draw attention to Haeckel's article on "Darwin as an Anthropologist." Man's place in Nature could not really be scientifically discussed until the theory of descent had been established. We now have the separate science of anthropology dealing with the physical and mental constitution of man. Its application to native races is especially important.

Further we may remark that a new branch of science has come into prominence, as an application of the theory of evolution to human affairs. I refer to Eugenics, which may be defined as the study of agencies under social control that may improve or impair the racial qualities of future generations, either physically or mentally. Sir Francis Galton was the pioneer in this study. We may commend it most earnestly to sociologists and politicians. On this important question I would quote the late Dr. R. H. Lock, who writes:—"The principles of heredity teach us that education and training, however beneficial they may be to individuals, have no material effect upon the stock itself. If they have any effect at all, this is undoubtedly unimportant in comparison with the effect which would be produced by the selection of individuals who exhibit desirable qualities. The demand for a higher birth-rate ought to apply strictly to desirables. Instead of this the cry is for education and physical training, processes which can have no permanent beneficial effect upon the race."

For myself, I would state that scientific methods need to be applied to modern administration. New countries, such as South Africa is alleged to be, seem to consider that it is necessary that they should undergo all the birth pangs of the older countries, and forget that they should profit by the experiences of the past—the world having evolved. The experiences of other countries should enable them to commence where other nations, so to speak, left off, and should help them to avoid the agonies of wasted effort due to the ignoring of evolutionary principles.

The underlying principles of general evolutionary biology should form an integral part of the education of all, for on an adequate understanding of these principles depends the proper conception of the relations of one individual to another. In particular, education, law and religion as wholes have failed to affect the race as they should have done. Lawyers need to study the broad principles of evolution, especially as their work is concerned constantly with a search for precedents and is in continuous contact with the more degenerate sides of human nature. Educationists and theologians need to turn to biology for the broadening of their outlooks on the human race and its possibilities. Administrators in charge of native affairs need to be conversant with anthropology and its teaching, and to be able to apply its results. Social reformers need to realise that transplantation to a better environment alone cannot regenerate the lower strata of society, for the great forces of heredity assert themselves constantly and the inborn nature, the inheritance of ages, comes to the fore when least expected. Environment may create a veneer or, better, allow certain traits to develop further, but it cannot entirely overcome or conceal the implanted and inborn consequences of heredity.

Let it be remembered that biology, of which evolutionary biology is but a part, is the science of life and of living organisms, and therefore should be a fitting study for living beings. Nature is universal, it is in process of slow but continuous evolution, and affords a constant, ever-present field for observation and experiment, whereby true inferences may be drawn. Cause and effect in Nature are inexorable, and the application of studies of such cause and effect would lead to a saner, happier and more moral world, wherein responsibility would be remembered, liberty not confounded with licence, and the simple truth would be appreciated, instead of, as is sometimes the case now, being either feared, suppressed, or sacrificed to expediency.

Lamziekte in Cattle.

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(Summary of Public lecture delivered under the auspices of the South African Biological Society. Pretoria, 24th. August, 1920.)

The researches into the cause and cure of Lamziekte in cattle were started some ten years ago, but very little real progress was made until 1914, when the Government realised the necessity of buying a Lamziekte farm in Bechuanaland where experiments could be carried out on an extensive scale. Since then the work has gone steadily forward, and has finally been crowned with success. Workers in different branches of science have contributed to this result, and amongst those who have been my colleagues in this work I may mention Prof. P. R. Viljoen, Dr. H. H. Green, Mr. D. T. Mitchell, Dr. P. J. du Toit, Dr. H. Meier, Mr. T. Meyer, and the staff of the Division of Botany under Dr. I. B. Pole Evans. It might have been supposed that the investigation of such a disease as lamziekte would only have been of interest to the Veterinarian, but all the biological sciences including bacteriology, chemistry, botany and entomology have contributed to the solution of the problem.

The symptoms of this disease are familiar to all farmers in Bechuanaland and other parts of the country where it is prevalent. The local name "lamziekte" is very appropriate, since affected animals are always partially or completely paralysed; in the early stages of the disease they attempt to rise but are unable to do so as the hindquarters become totally paralysed. The disease known as stijfziekte is similar in some respects

to lamziekte, but is due to different causes. In one form of stijfziekte caused by the stijfziekte bosch (*Crotalaria Burkeana*) the hoofs of the animal are abnormally elongated; in another form the joints become thickened.

A microscopic examination of animals affected with lamziekte shows that the muscles undergo certain alterations. The muscle tissues degenerate, producing fat, and the fibres later on break up into small portions.

Investigations into Lamzieke were begun nearly 40 years ago by the late Dr. Hutcheon, the former Chief Veterinary Officer of the Cape Colony. His views on the cause of the disease were correct in many respects, he considered Lamziekte and Stijfziekte as two forms of the same disease, which he maintained was caused by a lack of phosphorus in the pasture. It will be seen later on how far he was correct.

The first point to be ascertained in the experimental investigation of lamziekte was how the cause of the disease entered the susceptible cattle; whether it found its way through the mouth of the animal, or possibly through the skin. An experiment was made with 100 cattle, of which 50 were muzzled and the other 50 were left to graze unmuzzled. After a year nearly one third of the second lot had died of Lamziekte whereas none of those that had been muzzled had contracted the disease. The experiment eliminated the possibility of transmission by biting or sucking insects, and it was concluded that the cause of Lamziekte was taken in with the food of the animal. Suspicion was naturally directed to the veld as the cause of the trouble—the typical lamziekte pasture is grass veld with rosyntje and vaalbosch,—but it could not be traced to the presence of any particular plant in the pasturage. It was thought that possibly a toxin was contained in the grass which could cause the sickness. Grass was cut and fed to animals which were kept in the stable, *but they did not contract the disease.* Meanwhile animals which were left grazing

on the veld from which the grass had been obtained died from Lamziekte. This experiment effectively disposed of the poisonous plant theory.

Another theory as to the cause of Lamziekte was based on the one brought forward by Prof. Funk. According to him Lamziekte must be considered as an "avitaminosis", which means a disease occasioned by the lack of certain essential components (Vitamines) in the food. The best known case of *avitaminosis* is the so called Beri-beri, which in eastern countries makes its appearance as a result of the consumption of polished rice. Beri-beri may be brought about artificially in pigeons by feeding them on substances containing no vitamines, but in cattle it proved to be impossible to produce the disease in this way. Accordingly Lamziekte cannot be considered as an *avitaminosis*.

Yet another theory was that of Professor Hedinger whose opinion was that Lamziekte was an infection of the muscular system with parasites (*Sarcosporidia*). These parasites were detected in the flesh of animals that had suffered from Lamziekte; but later Prof. Viljoen proved that sarcosporidia were to be found in the flesh of almost all healthy animals as well. In one case he counted as many as 800 parasites to each square inch in the flesh of an emaciated animal which had never suffered from lamziekte.

It is obvious therefore that none of the theories expounded so far could explain the cause of Lamziekte; and investigators had to turn their attention back again to the veld. The first point for consideration was the possibility that the disease might be connected with insects. Among the insects which were suspected were the pupae of blow flies which are often to be found in the vicinity of carcasses lying on the veld. Pupae were then given to an animal and the first case of Lamziekte was obtained by ingestion, and there could be no doubt that the pupae contained a toxin that produced typical Lamziekte. It

was however, difficult to understand how pupae of ordinary flies or blowflies could be the cause of Lamziekte as cattle do not eat these insects; but it was observed that animals were frequently to be seen eating bones of carcasses lying in the veld. The fact that cattle eat bones is so well known in South Africa that farmers consider this quite a normal state of affairs. Animals were then fed with ground up bones gathered from a lamziekte veld: this resulted in *typical cases of Lamziekte. This was the first important step on the way to a solution of the problem.*

Naturally the bone in itself is not poisonous, and the investigators soon realized that its harmful properties were due to the presence of some germ. A large number of cattle diseases have been traced to the action of bacteria. Anthrax is the type of blood poisoning where the germs directly attack the blood, the spores may keep alive in the soil for long periods. Another example is Black Quarter Evil, a disease in which the organisms remain localised in one portion of the body, for example in the hind quarter, but produce a toxin which circulates in the blood and causes the death of the animal. In the case of tetanus the germs remain in the wound, and only the toxin gets into the body and produces the disease; no causal bacteria are found in the blood or tissues of animals affected with lamziekte and subsequent experiments showed that this disease is due to a toxin produced by the bacteria outside the animal body.

Bones and carcasses which had proved to be poisonous and had caused Lamziekte were submitted to a bacteriological examination and it was found that at least *three kinds of bacteria* were growing in them; one is a fairly thick rod and is the usual germ of decomposition; the second one has the shape of a tennis racket and the third the form of a drumstick. These germs were cultivated in the laboratory using minced liver as a medium; in this medium they produce

the toxin, and attempts to separate the toxin from the bacterial culture were successful. The question then arose as to whether the toxin was produced by only one of the three germs or by two or three in combination. Experiments proved that the culture of each one of the three used separately was not poisonous, but that in a culture containing a mixture of the racket shape and the drumstick shape or of all three organisms a powerful toxin was generated.

These germs are not found in all parts of the country nor even in all farms in districts affected with Lamziekte. Decomposed carcasses and bones will therefore not be poisonous on all farms, but only on those farms where the germs in question are present. This explains the reason why Lamziekte may be raging on one farm and may not appear on the adjoining one. Naturally such a farm may also become infected in time; the bacteria may be carried by animals, and it is even possible that the wind may blow the germs or their spores from one farm to another. The period during which the germs may remain alive in the soil has not been determined yet. The germs themselves are harmless. It is only after they have gained access to a suitable medium that they are able to grow, multiply and produce a toxin. In other words there will never be a case of Lamziekte, *if the farmer only sees to it that there are no carcasses or bones lying about in which the germs can produce the toxin.*

With this toxin, Lamziekte can be artificially reproduced in cattle; it is so virulent that 1/1000th part of a cubic centimetre per kilogram of live weight is sufficient to cause death, a few drops injected underneath the skin or about half a teaspoonful given through the mouth is fatal. It is interesting to note that it is possible to reproduce artificially in cattle *the different forms of Lamziekte* that exist in nature. In the chronic form of the disease the animals linger for weeks before dying or may even finally recover; this condition may be induced by

inoculating with a very minute quantity of the toxin. If a larger dose is given the animal may die within one or two days, showing the acute form of the disease including paralysis of the tongue and throat. A case has been recorded where two animals contracted the disease on the same day, one on the veld and one by artificial injection, these showed identical symptoms and died at the same time.

Although Lamziekte is essentially a cattle disease, other animals may become affected; it is known to affect goats and ostriches. Horses, sheep, rabbits and guinea pigs develop it after injection of the toxin.. Dogs, pigs and rats, animals which in their natural state live on carrion are practically immune.

From the experimental evidence adduced the following statement may be made with regard to the etiology of Lamziekte:—*Cattle eat bones or carcasses which in parts of the country are infected with certain bacteria; these bacteria produce a toxin which in turn causes Lamziekte.*

Cattle are herbivorous animals, and yet in this country it is not an uncommon sight to see them chewing bones for hours on end. The question naturally arises: why do cattle eat rotten bones and carcasses? To what cause may this abnormal craving be attributed? It was found necessary for further investigation to measure the degree of craving for bones, and a large herd of cattle was tested regularly each week on the experimental farm Armoedsvlakte to see whether they had developed bone craving or not. They were brought to troughs in which rotten bones had been placed; these were previously sterilised by boiling for one hour on three consecutive days. If this had not been done such animals as had the craving for bones would undoubtedly have contracted Lamziekte. Every week a number of animals noted to have eaten bones were recorded and the percentage marked on a chart. In this way a curve was con-

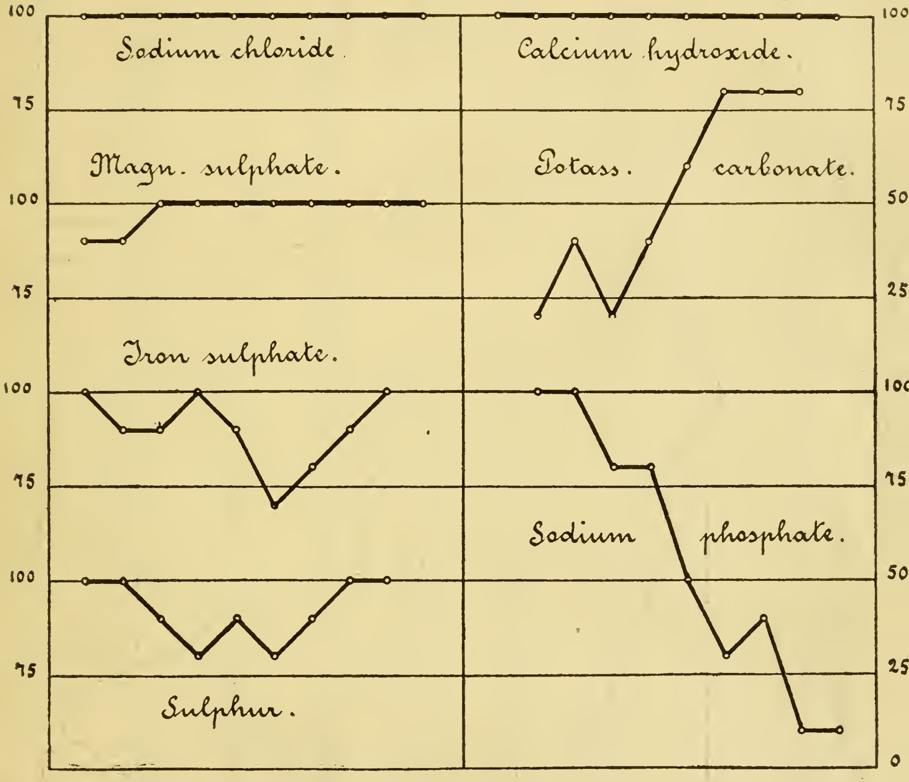
structed for the whole year. In May 1919, 40% of the control stock were eating bones, this number slowly increased till in August it reached 80%. In August and September the grass began to grow, and the degree of pica diminished slowly up to October, when after the first rains, the curve suddenly dropped to 5%, that is to say only 5 out of the 100 animals were still eating bones. So long as the grass was luxurious the number remained low, but at the end of November the grass wilted and the curve rose within three weeks up to 85%. During December and January the number remained equally high, except at the end of January, 1920, after the heavy rains in Bechuanaland, when it fell for a little while to 50%. Chemical analyses of the pasture grasses during the same period brought out the important fact that when the bone craving is acute the amount of phosphorus is low; and a curve showing the phosphorus content of the grass during the period showed that it was in inverse ratio to the degree of pica. From this it may be concluded that *bone-craving is caused by a lack of phosphorus in the food.*

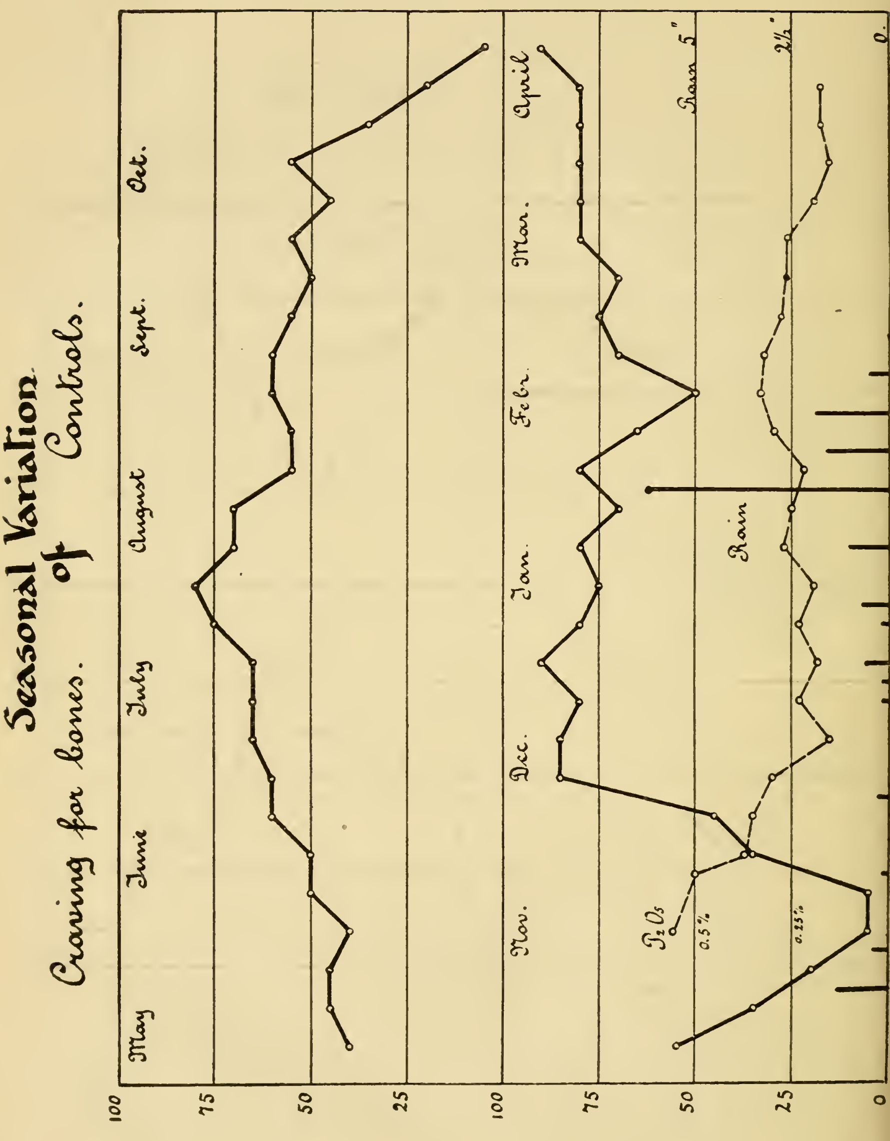
This was further corroborated by bringing a number of cattle from Pretoria; these had no bone craving, but after 7 weeks grazing on Armoedsvlakte 65% were affected with pica. When the bone cravers were turned into the stable and fed on the usual stable food, pica disappeared within a few weeks; if the same animals were again turned out on the veld they again developed the craving. This was not due to grazing on any particular variety of grass: a number of different grasses were tested separately, but all with the same result.

It was known that bone-cravers lost the craving within a few weeks when fed on mealie-meal, bran and lucerne hay, but it had not been proved which of the three ingredients of this fodder was responsible for this result. Mealie meal and lucerne were tried, without result, but the addition of 2 lbs. of bran to each day's ration made

Effect of

Craving for bones. Inorganic elements of plants.




Seasonal Variation
Craving for bones. of Controls.
May
June
July
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Sept.
Oct.
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0
P_2O_5
0.5%
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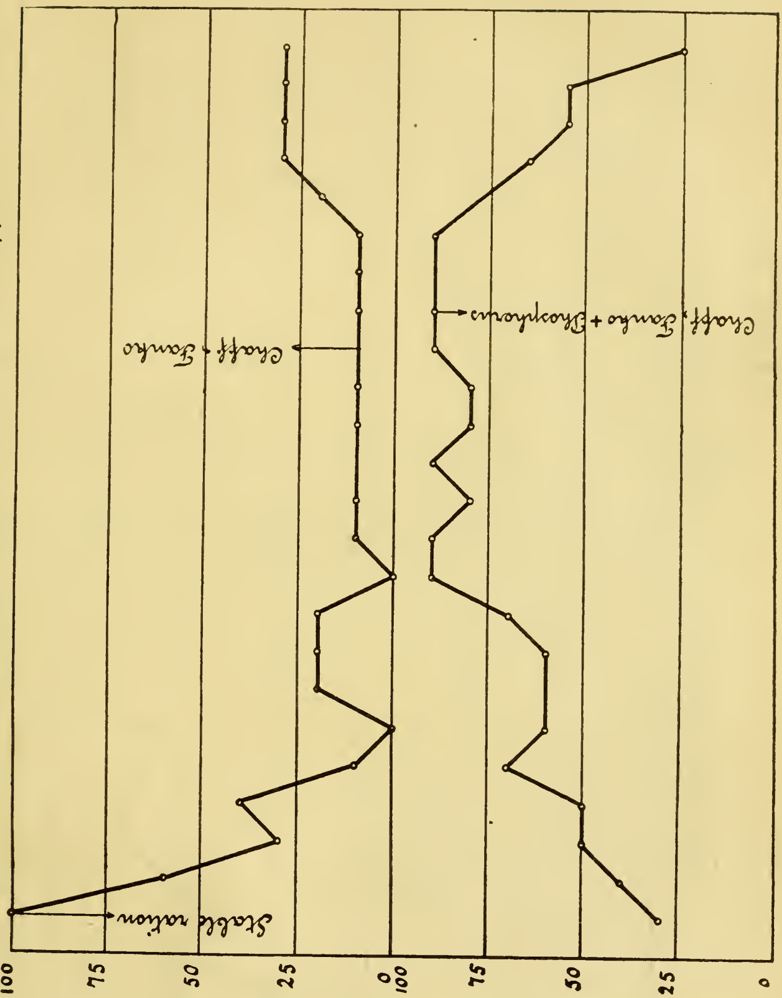
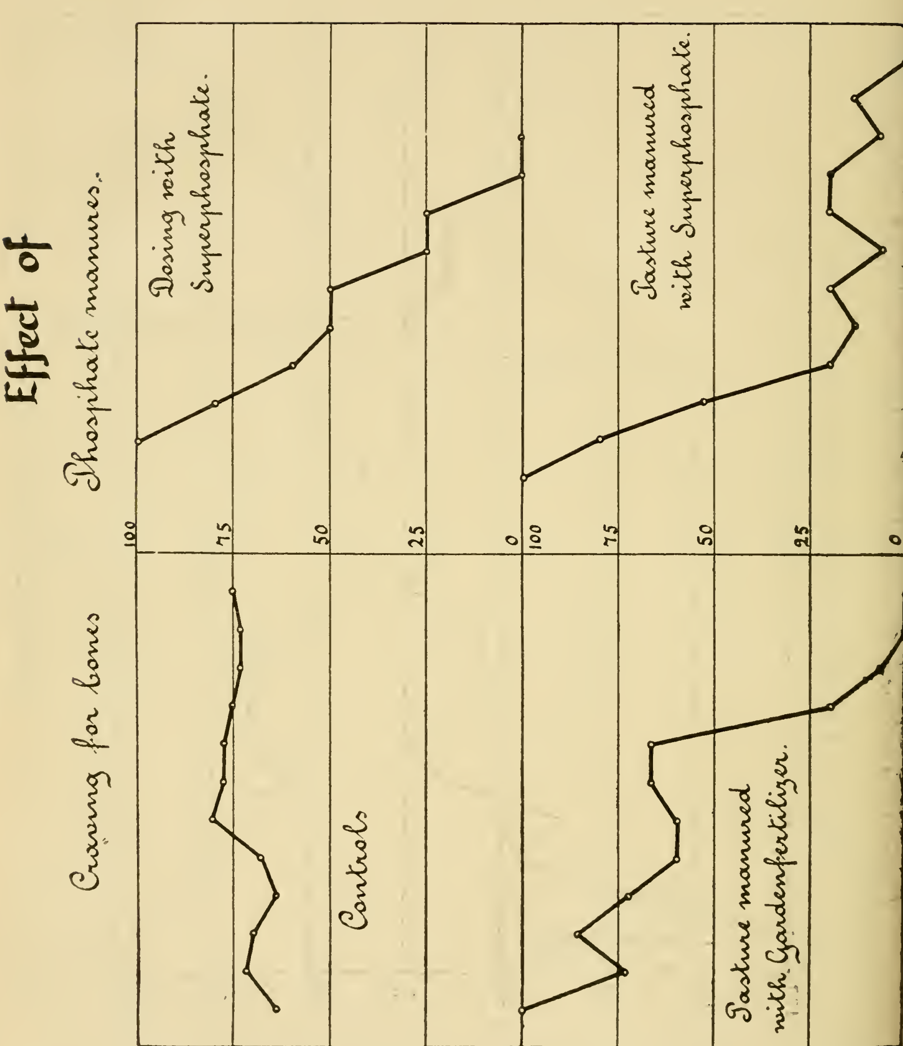
Craving produced by synthetic diet low in phosphorus.
Fanko { Endosperm of maize } and Chaff.




Effect of
Phosphate manures.
Craving for bones
Dosing with Superphosphate.
Controls
Pasture manured with Superphosphate.
Pasture manured with Gardenfertilizer.
100
75
50
25
0
100
75
50
25
0

pica disappear after a few weeks. Each of the mineral constituents of the food which eliminated pica were tested separately; common salt, magnesium sulphate, iron sulphate, sulphur and calcium carbonate were all tried but with only negative results; sodium phosphate however, reduced the bone-craving almost completely in six weeks. Here again it was a compound of *phosphorus* which eliminated the pica, and I have already mentioned that this substance was recommended by Hutcheon as a remedy for lamziekte.

Further experiments were carried out with a view to testing the effect of phosphorus administered in various ways: Pica disappeared in a short space of time after dosing with calcium phosphate, sodium phosphate and phosphoric acid, the last named substance can only be given with good results during the dry period of the year, if it is given during the rainy period the animals will drink rainwater and refuse to drink the water mixed with phosphoric acid, with the result that pica reappears. Phosphorus may also be administered by an indirect method: the pasture is manured with fertilisers which contain phosphorus, and the animals obtain it indirectly through the grass. Bone cravers were turned into two camps which had been manured with phosphates, after a short time the animals were free from pica, whereas the craving somewhat increased in the control animals which were grazing in a non-manured camp. This method cannot be recommended to farmers as it would prove much too expensive to manure big lamziekte farms with phosphates. The result is, however, very important from the theoretical point of view.

Many substances recommended as remedies by farmers were also tried:—prickly pear, herbs, coal, sulphur, salt, glauber-salt, hycol, cream of tartar, etc., etc., were all tested without having any effect whatsoever. Hydrochloric acid and nitric acid gave no relief, and negative results were also obtained with sodium oxalate or slaked

lime. As soon as the animals were dosed with calcium phosphate (the chief component of bone meal), or phosphorus, pica again disappeared.

In another experiment pica was produced by feeding cattle with a ration deficient in phosphorus. A number of bone-cravers were despatched from Armoedsvlakte to Onderstepoort and kept in a stable. After a short time the craving for bone entirely disappeared. They were then fed on chaff and fanko which hardly contain any phosphorus and slowly pica reappeared until 90% were affected. Again they were given phosphorus, and within a few weeks pica totally disappeared. There can not be the slightest doubt that pica was caused by a lack of phosphorus in the food and that the craving can be removed by feeding the animals with this substance.

The next point for consideration is the form in which phosphorus should be administered. Hutcheon recommended bone meal and it has been shown that bone meal fed in a quantity of ½ to 1 lb. per day removed pica within a few weeks. Whalebone meal gave the same result, but it took somewhat longer since it contains less phosphorus. Bone oil is useless; but dissolved bone meal or calcinated bones (bone ash), given in a dry form or dissolved, are all equally efficient in the elimination of pica; bone ash is less efficient than the other substances mentioned.

The best way to administer the bone meal is to feed the cattle at first with a larger quantity (½ or 1 lb. per day) for 2 or 3 weeks, until pica has nearly disappeared and then to continue with a smaller quantity (¼ lb. per day). The pica will not reappear. At Armoedsvlakte 50 draught oxen were fed on bone meal in this way and not a single one contracted lamziekte; the feeding with bone meal must not be stopped too soon or the pica will reappear.

It is not necessary to feed with bone meal all the year round. During the winter pica is at its height, but

cases of lamziekte are rare. The reason is that during the winter carcasses do not decompose so readily and are not so toxic as they are in summer. Small animals lying on the veld generally mummify; therefore it is quite sufficient to see that all carcasses are removed, buried or destroyed. The most dangerous period of the year is in spring when the grass wilts; at this time not only is the craving for bones at its maximum, but the bones and carcasses are most poisonous. Heat and moisture help the growth of the bacteria and the production of the toxin. If bone meal feeding is delayed until pica is acute it is necessary to give a large quantity (1 lb. per day); it is consequently more profitable to begin earlier, preferably immediately after the first rains when pica has almost disappeared. If feeding with bone meal be commenced at this time it will be found possible to ward off pica with a small quantity ($\frac{1}{4}$ lb. per day). It is not necessary to feed all animals on the farm with bone meal, the bone cravers should be picked out for this purpose: in this way the treatment can be carried out economically. If bone meal is to be fed to a lot of cattle, care should be taken to provide as many troughs as there are animals, otherwise the strong animals will chase the weaker ones away.

The total expense incurred in keeping the farm Armoedsvlakte free of rotten bones and carcasses amounted to £40 per year: there were over 600 head of cattle on the farm so that the cost works out at about 1s. 4d. per animal per year. The cost of feeding bone meal is about 5s. 3d. per animal which works out at about £158 per year for the lot of 600. The cleaning of the farm is therefore the cheaper method, but even the double method works out at less than 7s. per head per year, and the improved condition of the animals is worth at least so much. At present bone meal is the cheapest phosphate that can be obtained, but possibly later on there will be a cheaper article on the market which can be recommended. The

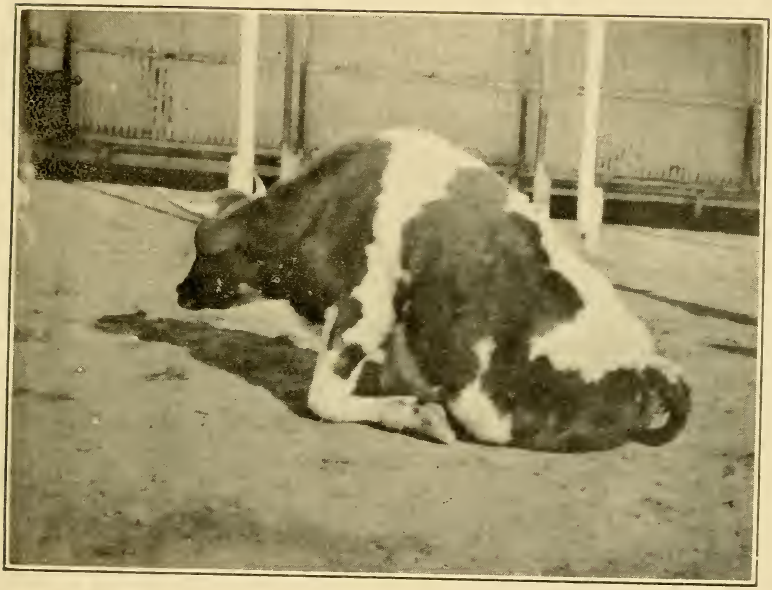
chemical factories at Somerset Strand are doing their best to achieve that end.

The practical results at Armoedevlakte have been excellent; during 1914 about $\frac{1}{3}$ of the cattle at Armoedsvlakte died from Lamziekte. In 1919 after cleaning the farm and feeding with bone meal the mortality was reduced to about 2%, and during the year 1920 not a single case of Lamziekte has occurred. A number of other farmers had equally good results.

No remedy is known which will cure animals suffering from Lamziekte, nor is an antidote known for ptomaine poisoning in human beings which is similar in some respects.

Some farmers are clamouring for a vaccine, but the prospects are not encouraging. When an animal recovers from lamzieke it is not salted, it may have a second and a third attack, and it then usually succumbs. Nature gives no immunity against Lamziekte, and what nature is unable to do man cannot hope to do, to expect that would be to expect a miracle. Hope is still entertained that an antitoxin may be discovered and a lot of work has been done in that direction, but success has not yet been achieved.

Lamziekte is only one of the many problems with which the Veterinary Department is confronted. The difficulty in the past has always been a lack of scientific collaborators: this difficulty exists even yet, and it is to be hoped that all these problems will be tackled and eventually settled when South Africa commences the training of her own Veterinarians.



An Account of the Flora of the Malvern District.

By Helena Forbes.

Malvern, a suburb of Durban, is situated about 10 miles inland on the Main Line. It is practically bounded on either side by the Umbilo and Umhlatuzana Rivers and beyond these rivers rise hill upon hill. The country in between these rivers is also hilly. On the whole the soil is not good, for the slopes are stony, most of the soil having been washed away by the rains, and in the valleys and lower parts it is very sandy. Some parts are almost entirely composed of clay with a slight top soil of sand and gravel. Most of the hill sides, although but sparsely covered with soil, are utilised by the Indians in the cultivation of bananas and pine-apples, while here and there the quaint, but nevertheless picturesque pawpaw trees are seen.

As this district consists chiefly of grassland and as grasses compose a very large and necessary portion of the flora, it will be as well to deal with them first. Apart from the fact that grasses are the essential food for all graminivorus animals, they are useful agents in keeping soil together. Their roots are mainly surface roots, and they help to keep even sandy soil from being washed away. *Andropogon nardus* (Tambuti) is the commonest grass and grows in great tufts over hill-sides, plains, and along roadsides. Other species of *Andropogon* found are:—*A. hirtus, A. halepensis, A. cymbarius, A. eucomis, A. pleiarthron, A. auctus. A. ceresiaeformis, A. marginatus, A. Schoenanthus. Imperata arundinacea is seen* everywhere, the silvery blooms being very pretty when young and fresh. *Tricholoena setifolia* and *T.*

rosea are also pretty grasses, and when the heads are all fresh and bright they make the field or brae look quite gay. *Panicum laevifolium* and *P. maximum* are the two commonest species of *Panicum*, other species being *P. curvatum*, *P. natalense*, *P. laticomum*, *P. isachne*, *P. dregeana*, *P. crus-galli* and *P. crus-pavonis*. Of the genus *Setaria*, *S. sulcata is the dominant*, *S. Lindenbergiana*, *S. imberbis*, *S. aurea*, *S. rigidus*, and *S. verticillata*—which clings by means of bristles to clothing and animal's furs,—are other species. *Eragrostis* species are also well represented, *E. aspera*, *E. gangetica*, *E. curvula*, *E. chloromelas*, *E. brizoides*, *E. tenella* and *E. plana* being found everywhere. *Paspalum distichum*, *P. scrobiculatum*, *Anthistiria imberbis*. *Axonopus semialatus*, *Tragus racemosus*, *Chloris elegans*, *C. gayana*, *C. virgata*, *C. pycnothrix*, *Ctenium concinnum*, *Eleusine indica*, *Dactyloctenium aegyptiacum*, *Phalaris minor*, *Leersia hexandra*, *Arundinella Ecklonii*, *Microchloa altera*, *Sporobolus centrifugus*, *S. pungens*, *S. indicus*, *S. Rehmanni and Tristachya leucothrix* complete the list.

The Umhlatuzana river is about two miles away from Malvern village, and the land on either side of the river is for the most part flat and very sandy, while here and there are large cliffs which are often about fifty feet or more sheer down to the water's edge. Aloes seem to thrive well on these cliffs and during June, July and August generally *Aloe natalensis* bears gorgeous heads of blooms. *Ficus natalensis* and *F. Petersii* also seem to be able to procure a living on these rocks.

Down at the River the Indians are cutting down all the trees and clearing away the undergrowth so as to plant bananas, even to the extreme edge of the kloof.

Growing in the water are floating masses of *Potamogeton javanicus* and at the edge of the water is *Scirpus cernuus*. Up till last year there used to be a fine lot of *Nymphaea stellata* growing in a fairly still part of the river. This last season there was absolutely no trace of the

plants. The Arum Lily (*Richardia africana*) does not seem to thrive well in this district as it is very rare.

In the moist ground at the waters edge are found the following plants belonging chiefly to the orders *Cyperaceae* and *Juncaceae; Juncus rostratus, J. lomatophyllus, Luzula africana, Triglochin striatum, Kyllinga alba, Kyllinga cylindrica, K. erecta, K. melanosperma Pycreus ferrugineus, P. flavescens, P. Mundtii, P. umbrosus, P. polystachyus, P. oakfortensis, Mariscus capensis, M. vestitus, M. elephantinus, M. Gueinzii, M. sieberianus, M. Owani, Eleocharis limosa, Fimbristylis complanata, F. diphylla, Scirpus prolifer, Ascolepis capensis, Fuirena glabra, F. pubescens, Ficinia laciniata, Bulbostylis collina, Bulbostylis Kirkii, Bulbostylis humilis*, while intermingled with the above are *Lobelia stellaroides, Melasma sessiliflorum, Crassula multicava, Oldenlandia macrophylla* and *Chironia purpurascens.*

Formerly there was a sandy strip of ground between the waters edge and the strip of bush land further back, but now this strip is a waving sea of green as *Phragmites communis* has taken possession of the ground and has spread rapidly. Here and there among this growth may be seen the heads of spiny capsules ol the *Ricinus communis* and both *Solanum giganteum* and *Solanum auriculatum* flourish well there. It is quite impossible to walk alongside this river in many places because of the dense growth of this reed.

Typha capensis and *Typha natalensis* are also found growing at the waters edge and round the sides of pools, while other plants which are found especially in moist localities are *Kniphofia Rooperi*, and *K. natalensis*, or "Red Hot Pokers", which come into bloom early in the summer, and *Clivia miniata*, another very handsome flowering plant which adorns the river banks in early summer.

The only fern which is found plentifully near the water and which thrives well despite *Phragmites communis*, is

Lonchitis pubescens. Other ferns which are found near the river or in moist places are *Pteris aquilina*—the common "bracken"—*Pellaea calomelanos, Pellaea involuta, P. hastata, Cheilanthes hirta,* while *Adiantum Capillus-Veneris* (Maiden-hair) and *A. Aethiopicum* prefer shady nooks.

Leaving the river banks we come to the trees and shrubs which grow plentifully on the slopes on either side of the river. *Eugenia cordata* is the commonest, and it grows everywhere, even within two or three feet of the water. Others which are also common are *Albizzia fastigiata, Erythrina caffra, Baphia racemosa, Trema bracteolata and Bridelia micrantha.* Creeping over these shrubs and trees are three very pretty creepers—*Jasminium multipartitum, Senecio tamoides* and *Senecio deltoideus.* Two very common flowering shrubs are *Iboza riparia* and *Jussiaea suffruticosa, J. suffruticosa* till quite recently seemed to belong exclusively to the river flora, but now it is found almost everywhere, quite large bushes flourishing well near the station.

In the undergrowth specimens of *Phaylopsis parviflora, Hypoestes verticillaris, H. antennifera, Cyathula cylindrica, Cassia bicapsularia, C. tomentosa, Barleria barbata, Crotalaria capensis* grow freely, while *Lantana camara* is rapidly spreading. Its growth is so rapid and dense that it is difficult for the smaller plants and undergrowth to survive.

Returning from the Umhlatuzana towards Malvern village, we pass through a field of China Guavas. Past this field is a stretch of ground almost bare but for dried grass and devoid of any trees save for one or two shrubs of *Acacia natalitia.* In the grass we find clusters of pods of *Abrus precatorius.* The natural beauty of this part of the country is being spoiled by the cuttings and embankments for the new railway. Later when the plants re-establish themselves, these parts may partly resume their former aspect.

The next part of the road, before one comes to the steep, sandy, winding pathway, is wooded on either side. *Eugenia cordata* is prominent among *Dalbergia armata, D. obovata, Oncoba Kraussiana, Combretum Kraussii, Trimeria alnifolia, Ochna arborea, Ekebergia Meyeri, Albizzia fastigiata, Celastrus buxifolius, Acacia pennata, Trema lanceolata, Ficus cordata, Ficus natalensis, Ficus Petersii,* while just at the edge are two or three large shrubs of *Carissa grandiflora* which may have been planted there at some time.

Few flowers thrive along the roadside. Certainly there is not much soil for them and the continual traffic of Natives and Indians may also account for their absence. *Aloe Cooperi, Aloe saponaria* and *Leonotis Leonurus* grow well despite the hard nature of the ground. *Eugenia cordata, Dichrostachys nutans,* and *Ficus natalensis* grow all along the way.

The pathway now leads up a fairly steep hill-side. In the various seasons many varieties of flowers are to be found. There is one place which is in July and August a perfect blaze of purple and white with *Watsonia densiflora* and *W. meriana.* Other plants flowering in their due seasons are *Dierama pendula, Ceratotheca triloba, Gladiolus papilio, Wahlenbergia undulata, Dicoma anomala, Crotalaria globifera, Wedelia natalensis, Asclepias flexuosa, Pentanisia variabilis, Conyza pinnatilobata, Aster natalensis, A. filifolius, A. asper, Pachycarpus inconstans, Senecio speciosus, Littonia modesta, Dicliptera heterostegia, Crotalaria lanceolata, Barleria obtusa, Ruttya ovata, Hibiscus malifolia, H. surattensis, H. pedunculatus,* and *Crocosmia aurea.*

The road now leads down a hill. At the top there is a solitary tree, *Sclerocarya caffra,* while the whole hill-side is destitute of flowers, but for one or two plants of *Ceratotheca triloba,* a few clumps of *Leonotis Leonurus* and two or three shrubs of *Uhdea bipinnatifida.*

Again we wend our way uphill, this time with hedges of *Carissa grandiflora* on either side. *Mikania natalensis* is creeping all over the hedges and besides the creeping *Vigna luteola, Crotalaria capensis* and *Lasiosiphon anthylloides* are the only flowering plants. The ground is really too hard and rocky to sustain many plants.

The rest of the way is through cultivated ground and an occasional specimen of *Bidens pilosa* or *Siegesbeckia orientalis*—both noxious weeds—are all to be found.

The next part of interest is a valley situated about mid-way between the Umhlatuzana river and the Umbilo. A small stream runs along the foot of the valley, bounded on either side by fairly steep rocky banks. There is scarcely any undergrowth but on each side there are shrubs and trees. *Psychotria capensis, Acokanthera spectabilis, Randia rudis, Clerodendron glabrum, Calodendron capense, Pavetta obovata, Pavetta lanceolata, Tecomaria capensis. Turraea floribunda, Turraea obtusifolia, Ochna arborea, Ehretia hottentotica, Halleria lucida* and *Burchellia capensis* are met with, while every here and there are large clumps of the tall graceful *Phoenix reclinata.*

The only ferns found along this stream are *Polypodium phymatodes, Pellaea hastata. Pellaea calomelanos* and the tiny moss *Funaria calvescens* is often to be seen on the rocks.

Further back where the ground gently slopes up, it is moist and the grass *Dactyloctenium aegyptiacum*, grows soft and luxuriantly. Here one finds *Ranunculus pinnatus, Cycnium racemosum, Lobelia coronopifolia, Eriospermum natalense, Geranium ornithopodum*, which flourish gaily, the delicate pinks, blues and whites blending harmoniously with the bright yellow of the *Ranunculus* and the fresh green of the foliage and the grass. Often nestling in the bank among the grass and other small plants are specimens of *Thunbergia atriplicifolia,* commonly called "Wild Primrose," their glossy cream

flowers contrasting and showing up well against their dark foliage.

Behind this where the soil is not quite so moist, many different species of flowering plants, both large and small, are found. *Lasiosiphon Kraussii; L. anthylloides; L. macropetalus* are very hardy plants and flourish profusely. Other plants growing there are *Scabiosa columbraria, Hebenstreitia comosa, Ceratotheca triloba,* compositae of many varieties including *Gerbera Kraussii, Senecio ruderalis, Senecio paniculatus, Senecio speciosus. Sonchus oleraceus,* several *Scrophulariaceae* including the dainty little *Nemesia cynanchifolia* which seems quite contented even in the dry soil.

As we go higher up the slope we come to dense bush. In the Summer the undergrowth is rather thick and as the shrubs and trees are fairly close together, it is not at all easy to make one's way through. Among the shrubs are *Randia rudis, Psychotria capensis, Acacia pennata*—a rambling shrub—*Acacia natalitia, Gardenia globosa, Ehretia hottentotica.* The larger trees are *Melia Azedarach, Albizzia fastigiata, Calodendron capense, Ficus natalensis, Celtis Kraussiana, Ficus cordata, F. Petersii, Erythrina caffra, Ekebergia Meyeri, Brachylaena discolor, Schotia brachypetala, Grewia occidentalis, Grewia lasiocarpa, Heteropyxis natalensis, Rhus natalensis, Drypetes argurta, Dalbergia armata, Dalbergia obovata, Dichrostachys nutans, Eugenia cordata, Anastrabe integrrima* and *Dombeya rotundifolia.* In their various seasons the flowering trees make bright spots among the surrounding trees. The *Schotia brachypetala* has bright crimson blossoms and is gorgeous when in full bloom. *Melia Azedarach* and *Calodendron capense* have mauve flowers and are very handsome when blooming, especially as their foliage is generally fresh and green. *Gardenia globosa* has showers of pure white bells while *Acacia natalitia* is a brilliant yellow.

There are a number of climbers and creepers throughout this portion of bushland. *Smilax Kraussiana, Asparagus falcatus* and *Rubus rigidus* are all spiny and are the three most troublesome as well as the commonest. Others which are common are *Ophiocaulon gummifera, Delechampia capensis, Abrus precatorius, Momordica involucrata, Ctenomeria cordata, Vitis hypoleuca, Trochomeria Hockeri, Riocreuxia torulosa,* and *Capparis citrifolia.*

The main road, and the small roads leading on to it. are the next to be considered. The road-side is generally dry and dusty but quite a variety of plants grow there. Most of the trees have been cut down, the few that are left being *Eugenia cordata, Acacia caffra, Melia Azedarach, Sclerocarya caffra, Erythrina caffra* and large clumps of the "Prickly Pear" (*Opuntia decumana* var. *spinosum*) which although really a native of South America is now quite naturalised. Most of the flowering plants are hardy though here and there one finds such plants as *Nemesia cynanchifolia, Lobelia coronopifolia* and the tiny creeper *Coleotrype natalensis* with its delicately hued flowers of blue, mauve and yellow. Other plants which are found are *Senecio ruderalis, Senecio paniculatus, Senecio pterophorus, Helichrysum agrostophyllum, Helichrysum floccosum, Sida rhombifolia, Sonchus orleraceus, Taraxacum officinale, Berkheya maritima, Berkheya subulata, Berkheya seminivea, Ricinus communis, Leonotis Leonurus, Lantana salviaefolia, Solanum duplo-sinuatum*, while *Gomphrena globosa* and *Alternanthera achyrantha* are fast becoming noxious weeds. Creeping over the shrubs are *Mikania natalensis, Vernonia angulifolia, Ophiocaulon gummifera, Momordica involucrata, Dalechampia capensis, Trochomeria Hookeri, Ctenomeria cordata, Rubus rigidus, Thunbergia alata, Helinus ovata, Rhynchosia orthodanum* and *Rhynchosia adenodes.*

The road to the Umbilo is very hilly and it is not at all picturesque. Indians have cut down—in most parts—all the natural growth and planted the ground with pine-apples and bananas. The soil is too dry and stony to be very fertile and the indiscriminate destruction of trees and shrubs has only rendered the ground more dry and unfertile.

On the way is a hillside which is left free from cultivation and is not exposed to the sharp winds. There are only a few stunted *Acacia natalitia* trees but during the flowering seasons there are very many different kinds of flowers. In October *Cycnium adonense* is everywhere while other plants found there are *Vernonia Kraussii, Ocimum oboratum, Hypoxis rigidula, Selago corymbosa, Bopusia scabra, Cyanotis nodiflora, Scilla saturata, Asclepias flexuosa, Drimiopsis maculata, Tephrosia elongata, Raphionacme divaricata, Cynoglossum micranthum, Vernonia dregeana, Senecio speciosus, Aster asper,* while the larger plants were *Asparagus africanus* in full bloom during October, with two large species of Vernonia, *Vernonia hirsuta* and *Vernonia natalensis.*

The roads to the Umbilo like those to the Umhlatuzana are merely Native tracks. Alongside grow many hardy types of plants. *Dicoma anomala* is very common as is also *Gomphrena globosa* and *Alternanthera Achyrantha.* Other specimens collected along the roadside or between the bananas were *Crotalaria capensis, Phyllanthus Meyerianus, Corchorus trilocularis, Melhania didyma, Alepidea longifolia, Lochnera rosea, Hibiscus pedunculatus, Ionidium natalense, Chenopodim ambrosiodes, Vigna vexillata, Eroisema parvifolium, Aster asper, Ceratophyllum demersum* (growing in pools), *Helichrysum griseum, Lotononis dichloides, Stachys nigricans, Justica pulegioides, Calophanes Burkeii, Desmodium hirtum, Aristea anceps, Aristea Eckloni, Sida capensis, Abutilon,* sp., and creeping along the ground among the grass and under-

growth are *Hydrocotyle asiatica, Richardsonia pilosa, Tephrosia amoena* and *Tephrosia macropoda.*

The plants which grow at the Umbilo are practically the same as those which grow at the Umhlatuzana. There is not nearly so much uncultivated land at the Umbilo, only a few yards at each side being untouched. Practically every hill-side on both sides of the river are farmed by native or Indians and naturally there is a great dearth of indigenous flora.

In parts along the banks the growth is very dense, but every here and there are large boulders, and in other places the Indians have cleared pathways. Wherever it can get a secure foothold, *Phragmites communis* is spreading.

Ageratum conyzoides is about the commonest flowering plant, while in crevices of rocks and at the water's edge *Polygonum serrulatum* and *Polygonum lapathifolium* grow well. Specimens of *Coix Lachryma-Jobi* have been found, but it is not common.

The banks of the river are inclined to be steep and here and there little krantzes relieve the monotony of banana and pineapple fields. The soil on the hillsides is not really good, being too stony and hard. On the top of the hill there is fine rich soil and the Natives reap splendid crops of Maize, Beans, and other vegetables in good seasons.

Other plants which grow practically everywhere and can really not be stated as belonging exclusively to any one place are given in the following list:—

Shrubs and Trees.

Gardenia globosa, Burchellia capensis, Phytolacca abyssinica, Vangueria lasiantha Zizyphus mucronata, Calpurnia lasiogyne, Heteropyxis natalensis, Fagara capensis, Royena villosa, Grewia lasiocarpa, Protorhus longifolia, Cussonia paniculata (commonly called the "Cabbage Tree" and not too common), *Plectronia*

spinosa, Rhus natalensis, Drypetes arguta, Clausena inaequalis, Schmidelia Africana, Capparis corymbifera, Celastrus acuminatus, Toddalia lanceolata, Apodytes dimidiata, Schotia brachypetala and all the Acacias—*A. caffra, A. Natalitia, A. pennata.*

Creepers:—

Riocreuxia torulosa, Capparis citrifolia, Helinus ovata, Caesalpinia sepiara, Clematis brachiata, Rhynchosta orthodanum, Kedrostis glauca, Rhynchosia adenosa, Ipomoea digitata, Ipomoea cardiosepala, I. ficifolia, I. purpurea, Cardiospermum halicacabum, Pyrenacantha scandens, Sphedamnocarpus galphimiefolius and *Dioscorea- malifolia.*

Herbaceous Plants and Others:—

Oxalis semiloba, Oxalis convexula, Oxalis corniculata, Physalis minima, Buchnera dura, Albuca crinifolia, Amaranthus spinosa, Sandersonia aurantiaca, Withania somnifera, Oldenlandia amatymbica, Anthericum pulchellum, Polygala oppositifolia, Polygala hottentotta, Anthericum elongatum, Anthericum capitatum, Vangueria infausta, Helichrysum teretifolium, Anoiganthus breviflorus (the little yellow fire-lily which comes up after the grass is burnt), *Erigeron canadensis, Dianthus prostrata, Aristea torulosa, Triumfetta rhomboides, Cassia mimosoides, Ethulia conyzoides, Hypoxis rigidula, Berkheya maritima, Pycnosthacys purpurascens, Achyropsis leptostachys, Alternanthera Achyrantha,* and many other small plants belonging chiefly to the Orders *Compositae, Leguminosae* and *Labiatae.*

There are two large bushy plants which are common all over. They both belong to the order Compositae and are natives of Mexico. They are *Uhdea bipinnatifida, Tithonia tagetifolia,* and *Tithonia speciosa.* The *Uhdea* bears clusters of pure white, heavily scented flowers, each flower about the size of a daisy "flower," while the

Tithonia has large bright yellow flowers about the size of a medium sunflower. These plants are quite naturalised now and are often included among the indigenous plants.

During the long summer evenings of January and February the air is laden with the perfume of an introduced species of *Oenothera* or "Evening Primrose," as it is commonly called. They are large shruby plants with fairly large yellow flowers, and grow along roadsides and waste ground. There are one or two species of *Loranthus* about this district. *Melia Azedarach* is the favoured host for *Loranthus Dregei*, and it is not at all uncommon to see large bunches of *L. Dregei* hanging from the branches. *L. Dregei* also grows on *Eriobotrya japonica* (Loquat) and I have also noticed *L. natalitius* var. *minor* on this same host. *L. natalitius* grows chiefly on *Acacia caffra* although the first specimen that I found was growing on *Acacia mollissima; L. Kraussiana* grows well on *Citrus Aurantium* (the Orange) as also does *L. natalitius* var. *minor*. *L. Dregei* also grows on *Aleurites triloba* and *Baphia racemosa*. Only once have I seen *L. Kraussiana* or any other *Loranthus* on a *Ficus—F. natalensis*. One frequently sees *Ficus Natalensis* beginning its life as an epiphyte on *Erythrina caffra* or some other tree. When it has once managed to establish its roots in the soil it grows so vigorously that it is frequently the cause of the death of its host, either by overwhelming it with its weight or else by depriving it of necessary light.

There are several orchids in this district. *Habenaria clavata* prefers a dry sandy soil and is almost unnoticeable amongst the grass. *Eulophia barbata*, a pretty purple orchid, grows on the dry roadside or among the grass, and is quite common round about Malvern. *Eulophia speciosa*, yellow and purple, grows better in moist places and is not nearly so common as *E. barbata*. The yellow heads of *Disa chrysostachys* show up among the grass. A very pretty epiphytic orchid is *Listrostachys*

arcuta. The blossoms are a creamy white and have a very powerful perfume. It is fairly common in the bush and it is a very pretty sight to see twenty or thirty sprays of flowers hanging from the branch of a tree.

There are a great many noxious weeds which grow freely all over the country side. [Some of these weeds are very troublesome pests to the farmers, and as they generally bear large quantities of seed, the only way to eradicate them is to pull up and burn all the young plants.] *Emex australis, Bidens pilosa, Sida rhombifolia. Siegesbeckia orientalis* and *Argemone Mexicana ochroleuca* (Mexican Poppy) are really about the worst. *Cannabis sativa* (Insangu) seems to have been spreading very much during the last few years. Some natives cultivate this plant and use the dried roots and leaves as tobacco, the fumes being quite as harmful as those of the Opium. Among the smaller plants are *Euphorbia hirta* and *Euphorbia inaequilatera,* and they seem to be able to withstand heat and drought, thriving well throughout the whole year. Other noxious weeds are *Xanthium strumarium, X. spinosum, Triumfetta effusa* and *Datura stramonium.*

During the last two years *Taraxacum officinale,* commonly called the "Dandelion", has spread enormously. Before that one occasionally saw a plant or two generally growing in moist sheltered places, but now it seems to grow everywhere, especially in the lawns. The leaves are said to be a cure for malarial fever.

Comparatively few Xerophytic plants are to be found in this district. A few *Helichrysum* spp. have heath-like leaves, as for example *Helichrysum cymosum,* while others such as *Helichrysum agrostophyllum* have leaves and stems covered with a white woolly coat of hairs. *Crassula sarmentosa* and *Kalanchoe rotundifolia* are two other xerophytic plants, *K. rotundifolia* especially being very common on the rocks near the rivers. *Osteospermum moniliferum* has also a very hairy covering over the leaves

and stems and the leaves are inclined to be succulent. This plant often grows in very dry places and unless it were xerophytic it could not withstand the long drought. The "Prickly Pear" (*Opuntia decumana* var. *spinosum*) is also a xerophyte, the whole plant being extremely succulent. Many of the *Liliaceae* are xerophytes. *Haemanthus natalensis, H. albomaculutus, Albuca crinifolia, Aloe saponaria* and *A. Cooperi* may all be classed as xerophytes, as they have decided xerophytic adaptations.

There are really very few Euphorbiaceae which are common. The only species of this order that I have found are *Euphorbia natalensis, E. hirta, E. inaequilatera, Cluytia pulchella, C. cordata, Phyllanthus Meyerianus* and the tree *Drypetes arguto.*

During the spring and early summer months hillsides, valleys and roadsides are ablaze with flowers of many different hues. In the early morning the flowers of *Ipomoea* spp. all open and the shrubs and trees festooned with their long twining branches are a mass of colour. In the winter there are the Aloes with their gorgeous heads of Orange, Red and Yellow, *Erythrina caffra* (the Kaffir boom) with its bright crimson sprays and *Leonotis Leonurus* with its gay whorls of orange flowers, so that at no season can one say that there are no wild flowers blooming.

This is merely a short comprehensive list of the Flora of Malvern, as no percentages, etc., have been taken, or gone into. Many of the plants mentioned are of medicinal value and are used by the Natives. *Helinus ovata*, for instance, a very common creeper, is a cure for sandworm. The leaves contain a substance, which, when rubbed in water produce a soapy liquid. If the affected part is bathed with this mixture the sandworm soon dies. *Aloe saponaria, Solanum duplo-sinuatum, Leonotis Leonurus, Fagara capensis, Pentanisia variabilis* and *Datura stramonium* are a few which are also used medicinally.

Notes on Animals of the Potchefstroom District.

By Ambrose A. Lane.

What wealth of wild life in the way of animals may have existed in this locality a hundred or even fifty years ago, must at present remain more or less a matter of conjecture, so many species having disappeared, or having been driven to more remote regions during the last half century. Whether the elephant, the rhino, the giraffe, and such like were ever numerous in parts where bush and trees were formerly more plentiful than is the case at present, it is not easy to decide; but that eland, quagga, and other large game formerly abounded is still well known, and the nomenclature of many farms in the vicinity gives evidence of favoured grazing grounds all over the district. Old residents in Potchefstroom have asseverated that they have stood in the main street of the dorp, watching the hunters in pursuit of lion along the reed beds below where the Vijfhoek Settlement now extends.

The largest wild buck I have seen were a few odd blesbok, which still survive on farms where they are more or less protected. I saw one a little over a year ago, just beyond the Mooibank Settlement. It had probably come across the river from Mr. van der Merwe's farm, on which and I trust some others, they are still preserved.

Springbok are still plentiful on outside farms where they are looked after, but otherwise nothing but an occasional duiker and a few steenbok remain of the enormous numbers of the antelope tribe which formerly existed, and even these are threatened with extermination. Some years before the war the officers of the garrison at Potchefstroom maintained a very sporting pack of

hounds and preserved these small buck as far as possible on the adjacent town lands. As usually results where genuine and experienced sportsmen combine for the purpose, the protection thus afforded gave excellent results during the few seasons while it lasted; especially as owing to the poor scent-retaining nature of Potchefstroom pot clay, the "smell dogs", as these fox hounds were nicknamed, seldom had much chance of getting on even terms with duiker, which were the usual quarry, unless, as rarely happened, they ran up wind; and thus duiker became fairly numerous quite close to the cantonments. Steenbok and hares are, however, frequently pulled down by a few fast greyhounds, and natives' lurchers account for many; but, although a run with "long dogs" affords a much more exciting gallop for the mounted followers, British sporting instincts only permitted it to be occasionally indulged in, so as to prevent wanton destruction of the smaller quarry which were none too numerous.

Besides the ordinary hares, the "spring-hare" is generally distributed, and, rarely issuing from its burrow except at night, is likely to maintain its continuance. The jackal, which was always sought by the hunt, was seldom encountered, though a certain number still breed amongst the more remote kopjes of the district. Strange to say, I nearly rode over one, one afternoon, just beyond the cantonments, a few weeks after the hounds had been disposed of in 1910. All I have seen in the district appeared to be the saddle-backed variety. The small hyena-like "manhaar" jackal I have not met below the bushveld district further north, but it may extend further south. Although I have come across burrows which indicated the existence of the "aard-wark" at a recent date, I only saw one specimen captured in the district, where they must now be rare. It seems a pity that such a curious and interesting animal, which is probably very harmless, should be so ruthlessly exter-

minated by the pot hunter. The hyena, proper, so far as I know has not been seen recently below the bushveld further north; nor have I come across a fox, but about 1908 I was shown the skin of a good sized lynx that had been killed a few days previously near the Mooi River, a few miles above Potchefstroom. This species, as well as the leopard, have probably disappeared from the district by now, though odd ones may possibly still elude extinction in the wooded hills along the Vaal or a few similar spots.

Not so long ago, I helped to kill a civet cat whilst driving one evening between a belt of wattles on the Government Experimental Farm and a holding on the Mooibank Settlement where a number of poultry was raised. The proprietor of the latter I noticed to be in pursuit of some quarry with his terriers, and almost directly afterwards the hunt crossed the road in front of my cart, being speedily joined by myself and a small fox terrier I had with me. The dogs drove the cat through the wattles into a patch of mealies beyond, and then back again, when it ran up one of the wattles, from which we dislodged it with stones, when, falling amongst the pack, it was quickly dispatched. It was the size of a large domestic cat, with somewhat similar shaped head, and in colour blotched with patches of deep russet and dark brown; but its most conspicuous feature was the long black and white ringed tail. As I never saw or heard of such an animal before, either here or in surrounding districts, where this one came from was quite a mystery (x). I have seen skins of the handsome spotted "tiger cat" and a commoner brown species killed in the neighbourhood several years back, but heard of none recently. I also some years ago saw the skin of the small scaly

(x) This animal is probably one of the genets (*Genetta*) of which two species most likely occur at Potchefstroom.—Ed.

ant-eater said to have been got locally, but it was the only one which came to my notice. The hedgehog is apparently scarce, though quite a colony of them existed near the town lands of Potchefstroom some years ago. Otters are probably still numerous along the Mooi River and the Loop Spruit, wherever extensive reed beds afford suitable cover. I do not know if more than one species occur, but those I have seen were of a large size. Most of the damage to poultry on riverside holdings attributed to otters, is, I fancy, caused by the large brown muishond, an animal seldom seen but probably plentiful in the reed beds. They are almost the size of a badger with thick, rather bushy, tails. Though of amphibious habits and good swimmers, they do not dive like the otter when pursued, but in a reed bed they are like the proverbial needle in a haystack, and I have seen a small pack of otter hounds the best part of two hours getting one out. The last I helped to hunt and kill was on the river below the Potchefstroom golf links. When close pressed by dogs they utter a loud cackling cry, and being stout and fierce animals at bay, it needs powerful and determined dogs to dispatch them, as is the case with the otter.

The local otter is quite as elusive to pursue as his British relative. One day, with the 4th Hussars' hounds on the Loop Spruit when in hot pursuit of a large otter, Capt. Courage and myself, who were mounted, got close up as he jumped off the bank and swam to the centre of a pool under a steep bluff on which were a few scattered bushes growing down to the water's edge. We quickly turned up and down stream to form "stickle" at the shallows above and below, but though close pressed by hounds, and the remainder of our party soon arrived and probed every possible place of concealment, we never saw him again. Otter hunting, which necessitates driving an otter to some spot where he can be surrounded by a crowd of keen pursuers and dogs, has been

condemned from a humanitarian point of view, but I think anyone who has had experience of the amount of physical endurance and energy entailed to kill a single otter, and knowing the remarkable resources, of the quarry, will concede it much more justifiable than his ignominious end in the jaws of a trap; besides, the otter having few natural enemies and being very destructive to fish, is as warrantable a quarry as any other.

The small skunk or black and white muishond is come upon now and again; and I have killed it close to the town, but it is now comparatively scarce, as its destructive propensities doom it to short shrift where homesteads abound, this plucky little beast being more inclined when encountered to show fight than to run away, probably, like its larger relative in the new world, relying on its evil smelling discharge for protection. An amusing incident occurred when, late one evening, as I was following my waggon, I heard my pointer barking and a considerable commotion on the veld some distance away. My kaffir boy reached the scene first, where the dog was baiting a pair of these muishonds, which, with all their hair on end, resembled two infuriated cats; they promptly set upon the boy, whom I met in precipitate flight, and afterwards bestowed their attention on me, when, having no weapon or missile to hand, I was obliged to retreat ignominiously, leaving them in the fast gathering darkness in full possession of the field.

In the way of lesser vermin, the red meerkats, which are plentiful on the veld, are frequently seen where loose sandy patches afford them favourable ground for their burrows, and in such places, where not much molested, they exist in considerable colonies. Near habitations their reputation as poultry thieves induces their extermination.

When I was first in Potchefstroom nearly twenty years ago, although the brown rat was often seen, the smaller black rat was still numerous, but I have not seen any

of the latter for a long time, so presumably the ubiquitous "mus decumanus" is pushing it out as has occurred in so many countries (x). Besides the the ordinary house mouse, the large mouse or small rat is common. It is usually about seven and three quarter inches long, of which the tail is about three inches, having four claws on the forefoot, and five on the hindfoot. The pretty striped field mouse is often found on the cultivated lands, but the tiny shrew mouse, though probably numerous, is seldom seen on the surface of the soil except when occasionally flooded out on irrigated land where water is being led. This tiny species, which I believe is *"Pachyrus gracilis"*, is only about three and a half inches long, of which the tail is nearly one and a half inches; and the two front incisors usually protrude perceptibly. I found one drowned, in a bedroom basin, which, to have got there, must have been disporting itself under the roof above. I never saw a shrew in a house before, but I believe the European species occasionally seeks shelter in garden sheds, and out-buildings during spells of frost (xx).

Troops of baboons still flourish in the hills along the Vaal, but this locality is probably their last resort in the district. Speaking of baboons reminds me that a monkey, similar to those occurring in the Rustenburg bush veld, appeared in the wooded portion of a farm at Mooibank, a few years ago, but upon being pursued by the whole family, made good its escape and was completely lost sight of. Whether it could have been a wanderer from the northern "low country," or had es-

(x) It is doubtful whether this is really the "Brown Rat" which occurs at Potchefstroom, the brown form of black rat (*Rattus rattus alexandrinus*) being usually mistaken for it.—Edd.

(xx) Shrews are not uncommon in houses at Grahamstown. (J. H.).

caped from confinement, is a moot point. The dassie still exists in limited numbers along a rocky ridge on the townlands of Potchefstroom and at a few similar spots, where rocky crevices afford secure retreats.

I believe a species of mole occurs in some localities, but I have not seen any specimens.

I have not identified any other species of bat except the ordinary small short-eared variety, which is numerous and often seems to insert itself between extremely narrow spaces that may occur between the iron sheets on a building, as if the housing problem in the bat world was a serious one.

Though I have seen quills and traces of the porcupine about what were probably former haunts, I think it is rare south of the bush veld further north.

There may be a few other odd survivors or chance wanderers of species that were once numerous still lurking about favoured haunts, but at present it is doubtful if this branch of the fauna of the district can be estimated at over two dozen species at present.

Birds of the Buffalo Basin, Cape Province. IV.

By the Rev. Robert Godfrey, M.A.

Cape White-eye — *Zosterops annulosa* (Sw.) — This resident species is widely-distributed in the Buffalo Basin, being specially common in the forest area, and occurring usually in bands which move restlessly and noisily onwards like tits, clinging as tits do in different attitudes to the twigs as they pursue their hunt. These little birds are specially noisy at dawn and just before retiring to roost. Mr. Wood says that in the winter

season a big family of White-eyes pass through his trees each morning with the regularity of clockwork. They seem always to come from the west and have possibly a set round which they make each morning. They generally inspect the leaves and twig-tops of the Kafir-booms a bit carefully, then pass on to the east. As this species and the Green White-eye seek their food in the same situations, they are in winter and spring occasionally found hunting in company. Both feed on small berries in the bush, and both haunt the nectar-bearing flowers of the Kafir-boom. I have likened the call of the present species to a low *teenk teenk*.

The nesting-season at Pirie lasts from December to March, the earliest eggs having been obtained on 14th December and the latest on March 2nd. The cup-shaped nest is slung along a slender twig, from which it projects horizontally; or it may be hung between two or three twigs and be supported by the twigs passing through the rim or the sides of the nest. It is a neat and firm but diaphanous structire, measuring 50-55 millimetres across the cup internally by 34-41 deep. A nest of the first pattern, projecting horizontally from its supporting branch is naturally longer than broad.

The nest is formed of slender pale green lichens and strands of bright green moss with a few wiry plant-stems and some vegetable down, held firmly together by spider's silk and a little wool. The cup proper is made of the seeding-tops of *Galopina* with a few lichen strands and a little wool round the margin; in the lower layers of the cup there may be present a quantity of fine wool, an odd feather or two and some spiders' cocoons, and in the shallow lining may be present some hairs and tiny tufts of wool. The diaphanous nature of the nest gives it a flimsy appearance, but the nest is firm enough for its purpose.

At Pirie the usual number of eggs is two, though sometimes three are laid. These are uniform pale blue 18 mm. by 13.5.

The Green White-eye — *Z. virens* Sund. — is a much rarer species in our neighbourhood than the preceding, but has its place among our resident nesting species. At East London it occurs in the shore scrub where it hunts in company with the last-named species through the thick bush, displaying its acrobatic powers as it searches for tiny insects on the twigs. In the neighbourhood of Pirie it is met with sparingly below, in and above the forest. On 14 February, 1911, one entered Miss Carry Ross' room to escape from a storm; when caught it uttered a cry of distress which reminded me of the shrieking made by kestrels when toying with each other in the air.

At Somerville, where the relative numbers of the two species are reversed, the Green White-eye is abundant. He knows the flower calendar and the fruit calendar to perfection. In July he accompanies the honeysuckers at the blossoms of the blue gum; towards the end of August he appears in the fig-fence at the first sign of the young figs, and while keeping his eye on the figs till the latter part of May he has meanwhile been visiting the apples and levying toll there. But we must give the little fellow his due; he is not always at the fruit. Often enough he works away in bushes and trees which have no fruit, and in spring and early summer he hops about perkily on the ground and helps us to get rid of our insect foes. I have seen one with a grub quite an inch and a half long; carrying it to a branch he settled down to deal with it. Holding the grub by one end and using it as a flail he beat it many times against the branch. Flying off with it to another perch he there repeated the process. He then worked the grub half through his bill and resumed the flailing. He continued the flailing till the grub was positively dead and quite limp, then striking an attitude for the final scene he gulped down the huge morsel with ease.

The ordinary call is a somewhat drawn out and softly metallic *teeng* or *teengk* which is often uttered and serves us as a guide to their haunts. Besides this call, there is a continued cry *tyeek tyeek tyeek* and also a short trill. The Green White-eye joins with the Bulbuls and other species in harassing owls whose day-quarters they may discover.

At the end of September the bands begin to pair out, and on October 22 I have seen one gathering material on the ground.

The nest of the Green White-eye was brought to me at Pirie on a single occasion only, 20 December, 1912. It was a neat small translucent cup, measuring internally 50 millimetres across by 32 deep, with visible 'pores' everywhere. In shape and material it resembled that of the Cape White-eye. It was made of slender lichens and green moss, with an odd leaf and spiders' cocoons in fair quantity. The lining consisted of *Galopina* fruiting-stems with one or two stems of another very slender plant.

The eggs, two in number, were of a uniform pale blue, decidedly smaller than those of the Cape White-eye, measuring 17-18 mm. in length by 12.5.

The Cape Bristle-necked Bulbul — *Phyllastrephus capensis* Sw. — occurs as a resident species in our forest tracts. Messrs. Center and Wood have obtained it in the coast-bush in February and September. At Pirie twelve specimens were brought to me by my little hunters, and a thirteenth was picked up dead by myself in the church-porch at Pirie on the morning of 4 November, 1913. What the bird was doing there away from its natural habitat I do not know, nor could I understand how it had gained access to the church.

Being of a very retiring disposition it seldom shews itself in the forest, and only once, on 29 June, 1911, did the species come under my observation there. I happened to be resting on the hillside above the forest at a spot from which I could peer over a low fringing tree

on the forest edge into a little gap among the trees. There a pair of these bulbuls were warily hunting for insects among the branches, and as soon as either bird came too conspicuously into sight it would suddenly dart off into shelter.

Between the 2nd of March and October 17th, however, I have often heard what I took to be the cry of this bird: it somewhat resembles the one-note song of the Anvil-bird, but is much more rapidly uttered and may very well be represented by the Kafir sound *nqu*, from which the Kafir name of the bird, *um nqu,* is derived.

The nest, authenticated by the snaring of the bird, has been brought to me on two occasions, on 14 December, 1909, and on 9 December, 1911. It is cup-shaped and formed of closely-oppressed layers of dead leaves and broad grass blades up to nine millimetres in breadth; externally and on the rim bright green moss forms an adorning girdle, and some exceedingly fine thread-like stems, perhaps of asparagus act in part as a binder to keep the material together. The lining consists of coils of a wiry plant-stem.

The eggs, two in number, are stone colour, thickly blotched at the larger end with dark brown, with lighter blotches and dark lines occurring in the same zone and more sparingly elsewhere. They measure 25 x 17 mm.

The stomachs of birds examined by me have contained insects, grubs and seeds.

The Sombre Bulbul — *Andropadus importunus* (Vieill.) — is one of the noisiest, if not also one of the commonest, of our bush-birds. It ranges throughout the forest area and over the mimosa districts and occurs even in isolated strips of cover in bare country. In our district this species is universally distributed.

The Sombre Bulbul is distinctively a fruit-eating bird, and comes to our orchards mainly for the sake of figs and apples. When working on such a large fruit as an apple, the bird simply sits beside the fruit and hews

away at it with its bill; but when feeding on berries it flies up to the tree and nips them off with its bill, or may cling to the fruiting-branch, sometimes in an inverted position, as it feeds.

The Kafir name *inkwili*, and the East London name of *Woolly*, are attempts to syllable the cry, which might be rendered otherwise as *cheer-eep*. This cry is the most monotonous sound in the forest, being heard all the day long, even during the midday heat and in rain. The cry is often slurred into a single note *kwli*, and the slurred note may be repeated many times in quick succession. The call *kwili* forms also the first note in the bird's song, which is continued in six or eight notes with a final drawl. The song, however, often ends abruptly without the terminating drawl.

On 26 July, 1908, when off work through sickness, I amused myself by noting the procedure of one of these birds. It began calling about 8 o'clock, called fifteen times, then rested a minute or two. On resuming it called eighteen times, then sang. It then called five times and sang again. The bird was evidently working itself up to its song by practising often on its call; and, when in form, the bird often gave two consecutive renderings of its song with only one intervening call.

My records shew that there is no break all the year round in the period of song, though fewer birds are singing in the first half of October.

On 11 July, 1911, I watched a party of these birds excitedly chasing one another rousing quite a different cry which was probably a pairing-cry; and on 27 August, 1908, I watched three of these birds calling and singing and chasing one another in breeding excitement.

At certain times this bulbul makes a clapping noise with its wings in flight as a honeysucker does; this seems to be associated with the breeding season.

At Pirie, a nest with two eggs was brought, without the bird, on 19 November, 1912. The nest was a compact-

ly built cup, measuring 70 mm. across by 40 deep internally. The outer casing of the nest consisted of green moss with an odd flake of lichen and one or two small leaves; within this was a composite mass of soft fibrous vegetable material with dry moss, wiry plant stems and a few twigs, lined with *Galopina* seeding-sprays. On the outside and rim of the nest, spiders' silk and a fine plant thread, apparently Asparagus, bound the material together. The eggs, 26.5 x 18 mm., were ellipsoidal in shape, of a creamy colour with a deep pink flush when unblown. Two kinds of markings occur on them, sienna-brown spots and scribblings and dull steel-grey spots and scribblings; the two kinds of markings are most profuse at the larger end, where they tend to form a band, and occur less sparingly elsewhere.

A few days later, 6 December, 1912, another nest with its owner was brought. This nest contained three eggs, one typical, but the other two differing so greatly in shape, in colour, and in measurements as to indicate a different origin. All three eggs were fresh, and these two may belong to a parasitic species.

Two young birds were brought to me on 29 December, 1910.

Cape Bulbul — *Pycnonotus capensis* (L.) — This species has not come under my own observation further east than Port Elizabeth, but it has been obtained by Pym in the neighbourhood of King Williamstown, at Balasi in 1906, and at Yellowwoods in 1907. These two specimens, as well as a male obtained at Draaibosch in October, 1916, and forwarded by H. Wilson, are in the local museum.

Mr. John Wood recorded in the S.A.O.U. Journal (II. page 123) finding a nest of this species with four half-incubated eggs at East London on March 29th.

Black-headed Bulbul — *P. layardi*, Gurn. — Known locally as the *Tiptol* and to the natives as *i-kwebula*, this species is one of the rowdiest and best-known birds in

our district. The song, from which he derives both local names, goes on without intermission all the year round. It may be rendered *kweet kweet kwee-bool-oo*, but is subject to much variation though always retaining a distinctive feature. '*Sweet potatoes*' may be taken as a very fair rendering when the first note is not repeated. On 21 August, 1910, I heard a Tiptol in a fence at Pirie singing a low chattering whisper of a song, which may have been an attempt to imitate some other species.

Its call consists of the first note of the song repeated *kweet, kweet*, and is one of the main elements in the uproar of small birds that leads us to the hiding-places of owls by day.

Like the rest of his tribe the Tiptol is an inveterate fruit-eater. In the wild fruits of the forest and of the bush-country he can find sufficient for his needs, and he knows exactly the order of the fruits. In May he revels in the berries of the wild currant, *Rhus laevigata*; in June he haunts the gum-tree; in July he is a conspicuous attendant of the Red Aloe, feeding first on the nectar and later on the seeds, and hanging sometimes upside down as he feeds; in August he visits the seeds of *Withania somnifera*; in September he joins the throng of nectar-loving birds that drain the Kafir boom of its wealth, and in October he levies tribute from the lofty spikes of the Cabbage-tree, *Cussonia*. On 12 June, 1908, I saw a one-legged Tiptol feeding in a Wild Currant tree and moving about with almost as much ease as a tit in spite of his handicap. He would settle on the shaky unstable mass of berry-bearing twigs, flirt his wings jerkily till he obtained a proper foothold. Having overcome the difficulties involved in poising himself he would pluck in succession a number of berries, flirting his wings after each grasp to steady himself, or he would slide right down a branch in somersault fashion, and, hanging inverted yet quite at his ease, would pluck the berries from a branch below.

But the Tiptol has long ere this found out how much more daintily he can fare by attending on man, and during the fruit-season he gorges himself on apples and figs, and in the autumn months he occasionally takes toll of the growing mealies. He varies his fruit-diet with insects, watching from a perch and sallying out to effect a capture and returning to the same perch, or another.

By the beginning of October the birds are paired, but my earliest date for the nest is November 27. Nesting goes on till the beginning of April. The nest, built in a tree, is a shallow cup of rough grass blades with some moss and is thickly lined with *Galopina* seeding-sprays. The internal measurements are 89 millimetres by 25.

The eggs, two or three in number, measure from 24 to 25.5 mm. by 17. They are cream-coloured with indefined markings of purplish-brown and steely-grey profusely covering the ground colour and tending to be of a more blotchy nature in a zone at the larger end.

Red-capped Lark — *Calandrella cinerea* (Gm.) — Essentially a bird of the open country, the Red-capped Lark abounds on the treeless tracts throughout our area. It is especially abundant on the flats along the base of the mountains, but also frequents suitable spots above the forest; it delights in dusty highways where it splashes about, as if bathing, in the dust. Unlike the Rufous-naped Lark, it rarely settles on an elevation higher than a termite-heap, though it occasionally perches on the top of a mealie-stalk or a Kafir-corn stalk, and once one of these birds alighted on the roof of a Kafir hut near which I was standing and ran across the thatch. Where both larks are present, this species is much more abundant than its relative; it is also exceedingly confiding, sometimes barely moving out of the way of a horseman, at other times running smartly along in front of him refusing to take wing until compelled.

The Red-capped Lark is a winter songster, its period of song ranging from 26 May to September 24. Generally

the bird sings on a termite-heap or other small mound, but he may even be content to sing from the roadway. But in July and August at least, these larks mount in the air a good while before sunrise and reproduce on a small scale the chorus of the skylark. These morning singers are unseen, but their identity is revealed by their using the same phrases as are used by the birds when singing on the ground.

The ordinary call of the bird as it rises from the roadway may be syllabled as *tsheerk*; this single note is lengthened in flight into a double note *tshee-ree*.

Nesting begins in the latter half of August, the 27th being the earliest date on which I have seen the bird carrying. At Somerville a fully-feathered youngster has been brought to me on September 18. Nesting continues till the middle of December. During the breeding season I have seen a pair of these larks rise fearlessly in front of my horse, 'billing' in the air as they did so.

Mr. Colley Macdonald informs me that a favourite site for the nest is at the foot of a mealie-stalk in the stubble-fields. I have neglected to enter in my note-books any detailed description of the nests I have handled. The eggs are two or three in number. The solitary egg left in my collection and taken on 7 November, 1908, measures 21 mm. by 15; the faint creamy-gray ground colour is covered fairly evenly with undefined spots and blotches of grayish-brown.

Immediately after the nesting-season, even as early as January 25, these birds congregate on the flats and remain in flocks until the following nesting-season. They feed on seeds.

Black-faced Lark — *Pyrrhulauda australis* (A. Sm.) — Dr. Edwin Atherstone recorded this species as occurring near King Williamstown and Stark also, probably repeating this record, makes a similar statement. At present, however, no proof is forthcoming of the actual occurrence of the bird within the limits of the Buffalo Basin.

Rufous-naped Lark — *Mirafra africana*, A. Smith — Over the treeless veld as well as the mimosa tracts of our area, right up to the edge of the forest, this lark is widely distributed and renders itself conspicuous by its habit of delivering its bold call of three or four notes from an eminence. In treeless areas it sits on a termite-heap or on a fence-post or even on a house-top; but, where such vantage-points as aloe-spikes or mimosa bushes are available, it prefers to drawl out its call from these, generally accompanying the call with a quivering of the wings. The lark utters this call all the year round, but is comparatively silent during the latter half of June and the first half of July. It begins at dawn even before the darkness is dispelled and is still calling after sunset.

The listeners interpret the call according to their mood. The Kafir herdboy believes the bird is conscious of his wiles and that it is saying '*se be fikile* (the boys have arrived, i.e., to torment us). Those on the prowl for Kafir-beer hear it jeering at them '*ndiya etywaleni*' (I'm off to a beer-drink), while a European may almost fancy the bird to be paying its respects '*How d'you do?*'

This drawl might pass for the song of the species, but some writers assert that at certain times the bird delivers a real song in the air. I have long endeavoured to settle this point, and I believe that a lark which on 21 November, 1912, twice mounted in the air to sing and which rattled through its phrases and descended, belonged to this species. I have no other personal evidence of this species singing in the air, and I suspect that, if the true song is delivered in the air only, it must have a very short annual period.

In addition to the drawling note already referred to, this lark has a plaintive call *weep;* and in summer it makes a characteristic noise with its wings, deliberately clapping them in flight as it passes from tree to tree.

Nesting begins in October, and a feathered nestling has been brought in by the Pirie boys on November 15.

On 29 December, 1907, one of these birds rose at my feet as I was riding through mimosa scrub and revealed its nest with unfeathered young hidden in the grass.

On 7 December, 1911, the boys brought a female with nest and eggs. The nest was not such as one, with experience of the European skylark only, would associate with a lark. It had been placed deep in its setting, and the broad grass-blades up to seven millimetres across forming the lower portion of the nest had been turned up behind and over the nest to form a back or half-dome to the structure. The receptacle for the eggs was shallow and lined with very fine vegetable material including a dense mass of pappus.

My latest date for eggs at Pirie is February 24.

The eggs, three in number, measure from 23 to 23.5 mm. in length by 16 to 18 in breadth. The eggs are whitish, with a more or less pronounced creamy shade, in ground colour; they vary greatly in the extent and in the intensity of their markings. The markings vary from minute dots to large irregular blotches 6 mm. long, and are grayish-brown, dark brown and steely-gray, with or without a zonal band.

Latakoe Lark — *M. chiniana* (A. Smith) — This species is recorded by Mr. Wood as occurring at East London in summer, but has not, to my knowledge, been met with in our area by any other naturalist. I have not handled a specimen.

Grey-collared Lark — *Certhilauda semitorquata* (A. Sm.) — The late Mr. F. Pym informed me that he had twice observed this lark at King Williamstown. On the latter occasion, 20 April, 1913, he met with one on the golf-links. In neither instance did he secure the specimen, but from his previous acquaintance with the bird he was certain of his identification.

Orange-throated Long-claw — *Macronyx capensis* (L.) — This species resembles the pipits in being a bird of

the open grass-lands. It frequents also the edges of the mimosa scrub and where suitable conditions exist it ranges from the shore-links to the mountain-slopes. It is a much more brightly coloured bird than any of its pipit relatives, and, when perched on a mimosa bush, the bright orange chin, separated by a black semi-circular band from the yellow of the lower parts, shews up to full advantage.

This long-claw has a very distinctive mewing call *me-yi,* which it utters generally in flight as it flies low across the grass, fluttering along with its white-edged tail at full spread. In addition, it utters from its perch on a termite-heap or on a bush a far-reaching whistle, which is so suggestive of human origin that a wanderer across the veld may well be excused if he looks round to discover the person who is calling him.

The prolonged nesting-period, from the middle of October till the latter part of February, suggests that the species is double-brooded. The first nest examined by me was shewn me by a boy on 29 October, 1908. Amid the short grass of the veld the birds had discovered a patch of longer vegetation, and in the centre of this patch had scraped out a hole to the soil below; in the cavity so formed they had built a cup-shaped nest of withered grass within the shelter of arching grass overhead. The nest was a comparatively firm structure, with some rougher and looser grass on the outside to keep it in position; it was lined with a thick layer of fine roots and measured in inner diameter across the cup 89 millimetres by 57 deep. Neither bird made any display at the nest. Other nests examined have sometimes contained black horse hair as part of their lining.

On eight different occasions the boys have brought me the female along with her nest. Whether the male assists in incubating the eggs remains unsettled. As indicated above the birds are undemonstrative at the nest;

even in the case of a nest containing well-developed young the owner did not call till I had left the nest.

The eggs, three or four in number, are ellipsoids of a clouded white ground colour, sometimes with a faint greenish tinge; they are thickly blotched all over, but less so at the narrower end, with various shades of brown and are frequently profusely spotted with steel-coloured marks. When fresh they are deeply suffused with pink. The eggs, like those of pipits, vary considerably in the richness and the extent of the markings; the overlying marks vary from minute specks in some eggs to blotches 3 mm. across in others. The measurements vary from 23-26 mm. in length by 18 broad.

The Yellow-breasted Pipit — *Anthus chloris* (Licht) — ranks as a scarce bird in Eastern Cape Colony. During my stay at Pirie I handled two; the first was brought in by a boy on 31 August, 1908, and the second, also by a boy, on 19 September, 1910. Only one other specimen to my knowledge has been obtained within our limits, and this individual taken by Mr. T. A. Newey at Draaibosch in April 1914 is now in the local museum. To the west of our area I have met with the bird once. On 17 September, 1912, Rev. D. B. Davies was driving me from Peddie to the Line Drift on the Keiskama, when he noticed one of these pipits on the veld. He drew up without causing the bird to take fright and shot it. Our native attendant gave it the name of *iguru,* which from its pronunciation is not a genuine Kafir word.

Plain-backed Pipit — *A. leucophrys* (Vieill.) — In the Buffalo Basin this is the common pipit in the open tracts below and above the forest, but, at a few miles' distance from the lower edge of the forest, it yields in numbers to the Tawny Pipit. Like its allies it feeds almost exclusively on insects.

Nesting begins in September and continues till January, the earliest and the latest dates on which eggs have been found being respectively September 26 and January

9. The cup-shaped nest is built on the ground and is formed externally of small grass-tufts and other rough vegetable material within which lies the cup proper, consisting in different nests of such varied substances as hare's fur, goat's hair, fine flowering grass-stems and fine roots with some rougher vegetable material.

Out of fifteen nests examined three contained four eggs, and in those cases where the sitting bird was obtained it has always been the female.

The ground colour of the egg is clouded white, with a faint greenish tinge in some cases and in others a decided stone shade; this is profusely mottled over with spots and blotches (inclining to streaks) of various shades of brown with underlying steely markings. As is usual among pipits, the eggs are subject to variation, and in some the underlying steely markings are missing. They measure on an average 24 mm. by 17.5.

How to Collect, Preserve and Study Insects in S. Africa.

Part III.

By A. J. T. Janse, F.E.S. (Lond.)

Before going on with the study of Lepidopterous insects I think it will be useful if I give information on the collecting and preserving of insects not belonging to this order, so as to enable the general collector of entomological material to give his attention to other orders as well.

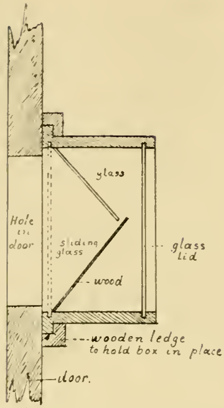
The *Coleoptera,* or beetles, first attract our attention not only on account of the many beautiful forms found in this order and the large number of its representatives in S. Africa, but also in view of the easy way in which they can be collected and preserved.

The collecting of beetles differs in several respects from that of the Lepidoptera, but some practice and the study of the haunts of these insects will soon enrich the collection with fine specimens, such as Longicorns and Buprestidæ.

Several kinds of beetles are attracted by lamplight, though this method of collecting will never prove to be as profitable as it is for moths. Still, many rare things may be obtained in this way, such as Carabidæ, Paussids, Pselaphids, Staphylinids, Longicorns and others. Some beetles again must be looked for in decaying vegetable and animal matter and for that reason damp kloofs abounding in trees will prove most profitable. However, there are many species that are carnivorous, such as the Carabidæ, and frequent open spaces amongst the grass, the rocks and on roads, or live in sandy places as do the quick Cicindelidæ. Flowers attract Cetonids, some Longi-

corns, Chrysomelids and others, while the gummy sap from Acacias often creates meeting places for Longicorns and Curculionids. The latter are also found in wild fruit, on and under bark of trees, and other beetles such as Buprestids, Elaterids, etc., may be found on branches and trunks of trees. Fungi very often harbour a number of small beetles, not to be found elsewhere, and the sifting of soil containing much humus will usually repay in minute forms after the bigger species have been sufficiently dealt with. Remember that among the smaller things there is most likelihood of discovering new species; and many, though unattractive to the naked eye, will delight the entomologist with an artistic taste on account of their beautiful pateerns and forms, when a magnifying glass is used. Not less interesting are such beetles as the Paussidæ and Pselaphidæ which live in ants' nests and perform there a function which causes ants not only to tolerate but even to care for them in the same way as we care for our pet dog or canary. Those who like to study the specialization of organs which environment and habits have brought about cannot do better than examine these often minute forms in their habitats.

With some species the butterfly-net is required, but in most cases their capture is to be done by hand. To catch the few water-beetles found in this country a small water net is necessary although several of the species are attracted by lights. The turning over of stones, the lifting up of logs of dead wood and the collecting of dead wood is often profitable, especially the latter method. Such dead wood is preferably kept in a small room of stone or brick, without a window and with roof and door close fitting. In the door a small hole is made, in front of which a box is fitted with glass bottom. The lid should slide in such a manner that it can be withdrawn and inserted without leaving an opening between the door and the box for the beetles to escape. When the lid is withdrawn the glass bottom serves as a window



Section through door and catching-box

fig. 1.

and the insects on emerging come to the light so that they can easily be caught and preserved. The box may also be arranged as a trap by means of a glass plate and a piece of thin wood set inside the box at an angle, in such a manner, that the beetles can get into the box but only rarely back into the room again. On a smaller scale any big wooden box can be used after openings have been closed up with strips of wood, not paper, and a few round holes may be bored in one of the sides into which collecting tubes are fitted, or a box as described above.

Often a bait may be used with advantage, such as a small piece of bad meat or fish. If this is placed in a wide mouthed bottle, and the bottle is buried in the soil up to its mouth it may be that in a day or two several carrion beetles, attracted by the smell of the meat, go inside but can not readily get out again. Very often, however, ants prove a great nuisance by getting in as well.

Cattle and horse dung often harbour special beetles, such as the Scarabæidæ. A ready method of collecting these, even the smallest species, is to throw the dung into a

bucket of water; the dung will sink, but after a little while the beetles will crawl out and float on the surface of the water when they can be caught easily.

I have said that very little is up to now known about the life histories of the Lepidoptera; this holds still more force with the beetles. Few entomologists in South Africa, if any, have given attention to this branch of science, yet it is most interesting from many points of view. The reason is perhaps the difficulty of rearing and even obtaining the larvæ of Coleoptera. However, the student of Coleoptera should not lose a chance of studying the life history of even the commonest species, and what is more, of recording the observations in full.

The Killing of Beetles.

This is best done. I think, with the cyanide bottle, though several workers use other methods such as: dropping the beetles into alcohol, or steeping a tin filled with them in hot water for half a minute or so. I do not like to bring any insect in contact with alcohol, if it can be avoided, as it often has an effect on the colouration of the insect. Only dull coloured insects, such as black and brown beetles might be treated thus without bad results, but red and green are often changed very much by alcohol. The brightness of the colour often disappears even by a dry treatment but this is not due to the cyanide. The hot water method is cumbersome, I think, as it necessitates the carrying of *living* beetles for some time, during which they may injure themselves and each other. It is true, that some beetles do not die readily in cyanide, some indeed may live for a day even in a strong bottle, but most of even those tenacious species will become somewhat stupified within fifteen minutes and thus harmless to others. Though I found that most beetles do not revive anymore after having been in a strong bottle for an hour, yet I always left them in the bottle overnight.

As beetles do not die so easily in cyanide as most other insects do, and as they often have very powerful jaws, it is always necessary to place in a beetle bottle a large number of small pieces of blotting paper, or paper shaving such as is found in boxes of sweets. This absorbs any moisture, which beetles often eject when in the bottle, thus preventing the soiling of other beetles and the paper separates the insects from each other so that they are less liable to do damage by their struggles. Great care must be taken with this paper, as, especially when moist, it absorbs large quantities of cyanide gas. It is a good plan to air paper and insects for an hour or so on an open tray, before any sorting is done.

Fig. 2 Killing bottle for beetles.

Small beetles should be collected in a separate and smaller bottle, and it is advisable to have this rather weak, so that certain species will have time to fold the wings underneath the elytra, which otherwise might remain spread out and thus prevent proper setting. The beetle killing bottles have, as a rule, a perforated stopper into which a short piece of thick glass tubing is inserted which again is closed with a cork. This enables one to open the bottle by the smaller cork without the risk of still living beetles escaping, provided the tube projects beyond the stopper into the bottle.

Packing.

When beetles have to be transported over a long distance before entering a collection it is perhaps better to pack them, instead of pinning them at once, as in the latter case, there is more risk of breaking the specimens in transit and also they take up much more room. Later, they may be relaxed either by placing them in pure water, or by making use of a relaxing box such as is employed for Lepidoptera. Even when pinned at once, the relaxing to set the legs, antennæ, etc., may have to be postponed when collecting far from home. Yet with delicately coloured beetles it is as well to set the specimens while quite fresh in order to preserve natural colours as much as possible. Some people preserve their beetles temporarily in alcohol of about 75%, or formalin of about 3%, but I do not favour this method, as explained before; also it makes all species more or less brittle. Nothing is gained by this "wet" preservation, as all parts used by the coleopterist are well chitinised and are just as well preserved dry. Only when anatomical and histological study is intended is the "wet" method essential.

The easiest, quickest and least bulky packing is clean sawdust, preferably from pinewood, mixed with naphthaline in a proportion of 5 parts sawdust to 1 part naphthaline. On the bottom of a tin box a layer of this sawdust is spread on which to arrange the beetles next to each other, without touching; these are kept in their place by the next layer of sawdust and naphthaline on which another layer of beetles is placed and so on, until the tin is full. When the specimens are from different localities, and of different dates, it is necessary to keep them separate by means of a piece of paper on which the information is written. A similar paper should always be on top of the last layer, *inside* the box, otherwise the scientific value of the specimens is lost

when this information is wanting. Some creosote or carbolic acid sprinkled on the top layer of sawdust will add still more to the preservation of the contents of the tin, but in order to prevent the formation of mould it is a good plan to keep the tin open for some time, and in moist climates to take special precautions to secure the quickest drying. I find that for quick drying nothing answers better than placing the open box filled with beetles in a still bigger box in which a few ounces of well dried calcium chloride has been placed. This will absorb all the moisture inside the two boxes. By heating the calcium chloride afterwards this moisture will be driven out again, making it ready for use once more.

If it is found necessary to keep the specimens separate they may be packed in a small piece of tissue paper with the ends slightly moistened and turned round by twisting between finger and thumb. I also find that little rolls made of paper, with one or a few specimens inside, tied up with a cross-thread will make neat packets which allow of ventilation and quick drying; moreover they can stand handling very well, even when the specimens are quite dry. To partly close up the ends of the rolls I use thread and needle, pass the needle through the paper at both ends and then tie its ends crosswise. Triangular envelopes, such as are used for Lepidoptera, and cottonwool also, should not be used for beetles. Very small beetles of say 5 mm. and less, should be glued on to bristol board. Get some good gum arabic and with a fine brush place a little in a line on the cardboard. Now, damping another brush, pick up with this your small coleoptera, one by one and arrange them next to each other on the gum. The smallest quantity of gum should be used, so that only the feet and abdomen on the underside come in contact with the gum, as otherwise it will be more difficult to remove the gum before mounting the specimens.

When beetles are to be mounted at once they should be pinned after removal from the killing bottle. Proper pinning contributes greatly towards the neatness and scientific value of the collection. Of course, only entomological pins should be used, as ordinary pins are much too thick and too blunt for the purpose, to say nothing of the length. Objection is often made to steel pins for Coleoptera, as they are said to corrode too easily, this is due I think to the protecting lacquer being scraped off by the hard chitine of the elytra, the exposed steel readily rusting in a damp climate, especially if the bottom of the boxes are covered with peat. In the Transvaal, however, I have never found these pins to rust excessively when used for Coleoptera, but near the coast there is a certain amount of risk. However, nickel pins are often destroyed along with the specimens they carry, by verdigris, though Coleoptera are not so easily ruined thus as Lepidoptera.

The pin should pass *perpendicularly* through the right elytron, so that the point will come out between the second and third pair of legs. This position will give the securest hold to the pin, without disarranging the elytra or legs, and if a well marked spot on the elytron is thus destroyed, it is preserved on the left side. Do not force the pin through the scutellum, as it will invariably crack that part and thus ruin the specimen. Raise the insect on the pin till only one third of a pin's length projects beyond the upper part of the elytra; whether the beetle is big or small, they will then all be at the same height, and to facilitate this uniformity a little block of hard wood with a hole in it may be used as a gauge. If the elytron is too hard to be pierced by a pin, a little hole can be drilled by a stout setting needle revolved between the fingers.

Next, the legs and antennæ have to be brought and kept in the natural position, which should be copied from the living specimen. The walking position is, perhaps

the most natural, but most workers prefer to place the legs on both sides in the same position so as to secure uniformity, e.g., the fore legs obliquely forward, the mid legs slightly backwards and the hind legs obliquely backwards. The knee part of all legs should be well raised,

Carabus beetle in walking position
fig 3.

otherwise the legs are stretched out too much. The underpart of the tarsi should be nearly level with the abdomen. To hold the legs in the required position, I use a piece of peat or pith of about one inch thick and fix the beetle on this till the abdomen nearly touches it. The legs are brought in position with a fine pair of forceps, and in small specimens with a hooked needle which one can easily make of a setting needle by heating in a spirit flame and bending the point over. To keep the legs in position, cross-pins may be used or,

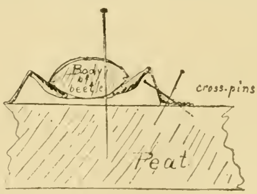
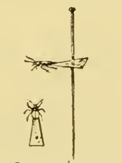


Fig 4.

simpler still, one pin with a little disc of stiff paper on it. The antennæ are also placed in a position so that they can be examined easily. In small specimens the legs can not be fixed thus, but after pinning, the insect is placed on a card on which some gum has been allowed to dry. Bring the legs in position as before, and apply a wetted paint brush to the tarsi thus moistening the

gum underneath. The gum will quickly dry when not too much moisture is used, thus holding the leg in place. After all legs have been treated thus, allow the insect to dry for about two weeks, then float the card with the insects on the surface of a little water so that the gum dissolves without relaxing or even touching the beetle and the pinned insect can be drawn from the card, while the legs remain in position. Beetles of about 4 mm. or less are seldom pinned, as even the finest pins would injure the insect too much. Such beetles are placed on gummed cards and held in place with a stiff brush whilst the legs are arranged. These are wetted again with the point of another brush, as explained before, and the beetle when dry is afterwards removed from the card in



Second mount for small beetles Fig. 5

the manner as indicated above. The specimen is then mounted on a second mount consisting of either bristol board or celluloid. The former mounts usually have a pointed shape and the abdomen only is attached thereto by gum, the legs projecting beyond the card; this facilitates the examination of legs. If more than one specimen is mounted, one may be mounted upside down, to allow easier examination of legs and mouth parts. In some cases it may be necessary to mount one or two specimens in flying positions; an ordinary setting board as used for Lepidoptera will answer the purpose.

For cleaning specimens before mounting, warm water containing ammonia will be found servicable, while a fine but stiff sable brush can under water remove dirt in a mechanical manner.

The well dried specimens are now each supplied with a locality label and then arranged in the insect box as explained for Lepidoptera, with this difference, that the specimens of the same species are usually arranged in horizontal rows within the columns and not in vertical rows as is generally done in the former group.

Some collectors poison the beetles with corrosive sublimate to prevent them from being eaten by other insects, but I prefer to rely on well fitting boxes and the use of ample naphthaline, as the sublimate may crystallize on the outside, thus spoiling the appearance of the beetle; moreover it tends to corrode the pins.

Adaptations for the Dispersal of Fruits and Seeds.

By E. P. Phillips, M.A., D.Sc., F.L.S., Division of Botany, Pretoria.

In 1894 Dr. R. Marloth, then President of the South African Philosophical Society, chose as his Presidential Address a subject entitled "On the Means of the Distribution of seeds in the South African Flora". The writer in 1913 gave an illustrated lecture on the same subject to the Members of the Cape Town Section of the Mountain Club of South Africa and a resume of the lecture was published in the "Mountain Club Annual" for 1913.

The studying and recording of the various adaptations for dispersal found in fruits and seeds will never lose its fascination for naturalists and not withstanding that the subject has been treated so fully by Dr. Marloth it may not be out of place to bring it before members of the Society. Dr. Marloth's account is not generally available and the present short sketch may serve not only to open

a new channel of interest to Members but may also point to a profitable line of observation and investigation.

In almost all accounts on this subject based on the South African flora, certain stereotyped examples are given and the present paper is not free from this fault. It will only be when observers stationed in various parts of the country can be induced to accurately record their observations and either publish these as "Natural History Notes" or forward their records to some central authority, that a scientific and detailed account of the various adaptations found in the fruits and seeds of our native plants will be written.

All the higher plants, i.e. the plants met with on montain or veld have one character in common—they remain throughout their lives on the spot where the seed germinated. In this respect they are unlike animals which have the power of free locomotion. As plants are stationary it becomes imperative that the fruits and seeds produced by them should be scattered the greatest possible distance from the parent. If this was not done there would be an un-natural crowding of individuals of the same species within a very limited area, all requiring the same conditions of light, moisture and mineral food and in the fierce competition that would result among the individuals the species would suffer. It is to prevent this congestion of individuals, that we find in nature a multitudinous variety of devices for carrying the seeds away from the parent plant.

It is unfortunate that when plants are in the fruiting and seeding stage they do not attract the same attention as they do when in flower. They nevertheless deserve the same or rather more notice and this will usually be amply repaid by the beautiful contrivances often met with for dispersal.

Not every seed set by a plant will germinate, many do not alight on suitable spots for germination and many are destroyed by animals. If only a very small percentage of

the seeds formed by a single plant germinates and grows to maturity the species is in no danger of extinction. Some plants produce countless thousands of seeds as for example the heaths and orchids so that in these cases only a small fraction per cent. need survive to carry on the life of the species.

In seed dispersal we must distinguish between (1) occasional or accidental and (2) regular methods of dispersal. In South Africa we have examples of the former during the summer-floods when seeds and fruits of plants may be carried great distances from their place of origin. It is by this means that some of the noxious weeds are spread over the country. The accidental dispersal of seeds throws light on many questions of the geographical distribution of plants, such as the planting of oceanic islands; the presence of stray plants from one flora in the midst of an alien flora, etc. Ocean currents often carry seeds and fruits long distances. The seeds of *Entada scandens,* an East African leguminous plant, have been found on the shores of Little Namaqualand and also on the beach near Cape Town. We have records of seeds and fruits found on the west coast of England which have been carried across the Atlantic by the Gulf Stream. Many aquatic plants are distributed by their seeds or fruits adhering in mud to the feet of birds feeding on the banks of the river or vlei. Human agency is to-day an important factor in the accidental dispersal of seeds. We know only too well the weeds which were imported into South Africa in bales of forage from Australia and America during the Boer War. Even small islands far removed from the mainland are colonised by cosmopolitan weeds in this way. From Tristan d'Acunha for instance the writer recorded many temperate weeds which were not collected by the Challenger Expedition of 1873-1876.

In the regular methods of seed dispersal four agencies are employed: 1. *Wind.* 2. *Water.* 3. *Animals.* 4. *Contraction of certain tissues of the fruit.*

1. Distribution by Wind.

The dispersal of fruits and seeds by the wind is perhaps the most common means employed and two distinct methods are found in nature (a) plants in which the fruits open allowing the enclosed seeds to escape and (b) plants in which the fruits with their contained seeds are carried away by the wind.

Plants in which the fruits open to allow the seeds to escape:—

(a) The seeds are excessively small and light and are blown away like fine dust. (Pl. III. fig. 12.) This type of seed is found usually in species of *Orchidaceae*, *Ericaceae* and *Caryophyllaceae*. In plants belonging to the above Natural Orders, the mature fruit opens by slits or pores, the ripe seeds lie loose within the fruit and when the fruit is violently shaken by strong winds the seeds escape and are blown away long distances. Some idea of the size of these seeds can be formed when we find that about 26,000 seeds of *Erica coccinea* only weigh one gramme. This estimation was made by Dr. Marloth.

(b) A somewhat similar method is found in plants which have dry fruits. In these plants the fruits open only sufficiently to allow the seeds to escape if the fruit is violently shaken. (Pl. III. fig. 1.) Good examples are found in many *Iridaceae* and *Liliaceae* in which the seeds are flattened or winged and suitably adapted for wind-dispersal. The common "Stinkblaar" (*Datura stramonium*) is a plant of this type. The fruits are spiny; passing animals shake the fruits so that the seeds are thrown out. A similar type of fruit is also found in *Erythrina acanthocarpa* (Pl. III. fig. 25.) The common "Khaki Weed" (*Tagetes minuta*) brings about the same result by different means. The involucre is in the form of a tube and the fruits lie loose within the involucre. Animals brushing past the bushes cause the fruits to fall out. Each fruit is armed with a few terminal spines

which adhere to the body of the animal and may be carried very long distances from the parent plant.

(c) A very common adaptation is the development of wings on the seeds. This greatly increases the surface area and allows such seeds to be easily blown about. In *Pinus* a single membranous wing is developed; in *Tecomaria capensis, Markhamia acuminata*, (Pl. II. fig. 4.) *Welwitschia mirabilis,* (Pl. II. fig. 14.) *Sesanum sp.* (Pl. II. figs. 19, 20.), etc. 2 wings are developed, one on each side of the seed. In *Anacampseros* numerous small wings are developed. It is usual for winged seeds to fall with a spiral motion; thus the time during which they are suspended in the air is lengthened.

(d) The development of hairs on seeds is perhaps the most common adaptation found for seed dispersal. In the *Asclepiadaceae* (*Stapelia, Asclepias*, etc.) and some *Apocynaceae* (*Strophanthus speciosus*) (Pl. II. fig. 5.), an apical tuft of hairs is formed. In some species of *Apocynaceae* a tuft of hairs is developed at both ends of the seed while in the Willow (*Salix*), the cotton-plant (*Gossypium*) and *Eriospermum* (*Liliaceae*) (Pl. III. fig. 10). The seeds are covered with long hairs.

In the dispersal of fruits we find the same methods adopted for wind dispersal as is found in seeds. In fruits which do not open we never find winged seeds.

(a) The fruits of *Cassia arachnoides,* (Pl. II. fig. 6.) one of the *Leguminosae,* are flattened and membranous and suitably adapted for being blown long distances by the wind.

(b) The development of wings is found in the fruits of various species of *Leucadendron* (*Proteaceae*) (Pl. II. fig 2.); *Dimorphotheca* (*Compositae*) (Pl. II. fig. 17.) which have 2-winged fruits.

Three wings are developed in the fruits of *Tripteris* (*Compositae*) (Pl. II. fig 10.), *Begonia* (*Begoniaceae*). Many species of *Combretum* (Pl. II. fig 12.) have four wings and other examples may be quoted of fruits with 5-6 wings.

(c) Hairy fruits are not so common as hairy seeds but examples are frequently met with. In the *Compositae* this is the common adaptation for wind dispersal. At the apex of the fruit a tuft of hair termed a "pappus" is usually developed. (Pl. II. fig. 8.) In *Tarchonanthus camphoratus* and *Eriocephalus umbellatus* both members of the *Compositae* the fruits are woolly. In the *Proteaceae* hairy fruits are found in species of *Aulax* and *Protea*.

(d) A few fruits become much inflated when mature and form suitable objects for being blown along the ground by strong winds. As the fruit is blown about the seeds escape through slits in the fruit wall. Such fruits are found in *Sutherlandia frutescens,* many species of *Lessertia, Aitonia capensis,* (Pl. II. fig. 7.) *Melianthus major,* etc.

In the above examples we see that either the seed or fruit is adapted in some way for wind distribution but we also find cases in which other parts of the plant become modified to serve the same end. For instance in species of *Polygala* the 2 side sepals become enlarged and serve as wings. In *Dombeya natalensis* the petals are persistent and remain on the plant in the fruiting stage, while in species of *Statice* (Pl. II. fig. 3.) and *Grielum* the enlarged calyx serves as an apparatus for carrying away the fruit. The styles may also serve this end as we find in *Anemone capensis* and *Clematis brachiata.* In many South African grasses the glumes are feathery and serve as an apparatus for wind dispersal. The Silver Tree (*Leucadendron argenteum*) and *L. plumosum* (Pl. II. fig. 13.) exhibit a very fascinating method for dispersal by the wind. The old perianth is persistent and slips up the style but is prevented from falling off by the swollen stigma, the whole arrangement forming a perfect parachute arrangement. In a few cases e.g. *Brunsvigia multiflora* (*Amaryllidaceae*) the whole of the fruiting inflorescence, which is sometimes 2 ft. in dia-

meter is blown about by the wind and scatters the seeds as it travels along. In *Cardiospermum halicacabum,* the septa of the fruit remain attached to the seed and form a large wind. (Pl. II. fig 1.)

2. Distribution by Water.

South Africa does not possess a very large aquatic flora and the two best examples of water distributed fruits are those of *Nymphaea stellata* (the Blue Water Lily) and *Aponogeton distachyon* (Water uintje). In the former the seeds are hard with a black shiny coat; inside is a small cavity filled with air which makes the seeds buoyant. When germination takes place the seed sinks to the bottom of the pond or vlei and takes root. In the "water unitje" the seeds are enclosed in a membranous capsule and when the capsule bursts the seeds which have an oily coat float on the surface of the water. The seed eventually escapes from this oily coat, sinks to the bottom of the pond, and there germinates.

3. Distribution by Animals.

Animals act as the agents for the dispersal of fruits and seeds in two ways (a) they use the seeds or fruits as food and any which have survived the passage through the alimentary canal may subsequently germinate or (b) they carry the fruits or seeds on some part of their body. This latter is an accidental process.

Seeds distributed by birds have usually succulent juicy and coloured fruits and to prevent the bird taking the fruit before it is fully ripe, the still unripe fruit is hidden among the leaves, has a green colour and is destitute of scent. On ripening the fruits are exposed, usually bcome coloured and emit a strong scent. In some succulent fruits such as our native species of *Viscum* (Mistletoe) and *Loranthus* which live as parasites on

trees and shrubs, the seed (stone) is not swallowed by the bird. The fleshy portion is sticky and the bird to get rid of the seeds which adhere to its bill, wipes them off on to a branch. In this way the seed is placed in the most advantageous spot for germination. In many fruits which are not succulent the seeds are either coloured or possess an appendage called an "aril". This aril serves as an organ of attraction to birds.

The unintentional or accidental dispersal of seeds is of common occurrence and about 10% of plants have contrivances of some kind for animal distribution. The seeds or, as is more usually the case the fruits, are furnished with hooks, spines or are sticky.

In *Geum* (*Rosaceae*) the nutlets are each furnished with a hook while in *Bidens pilosa* there are two barbed bristles with reflexed hooks which form a very effective apparatus for clinging to passing animals; two spines are produced at the apex of the fruit of *Tagetes minuta* which answer the same purpose (Pl. III. fig. 9.) In *Agrimonia* (*Rosaceae*), *Xanthium spinosum* (Bur-weed), *Medicago spp.* the fruits are covered with spines. The "Grapple Plant"—*Harpagophytum procumbens* (*Pedalineae*) (Pl. III. fig. 14.)—has an effective, if cruel, method for seed distribution. The fruit is covered with long woody somewhat elastic spines with recurved hooks. The plant, which trails along the ground, has the fruits so placed that an animal treading on them carries away the fruits which cling tenaciously to the foot. In attempting to get rid of the clinging fruit the animals stamp it to pieces and thus the seeds escape from the fruit. *Pretrea Zanguebarica* (*Pedalineae*) (Pl. III. fig. 2, 20.) has a fruit flat on one side and convex on the other. On the flat surface are two erect spines and the structure of the fruit is so formed that the spines lie uppermost. The spines will penetrate the hoof of an animal treading on them and in this way the fruits may be carried some distance before they become detached. The late Prof. Mac-

Owan wrote concerning the "Grapple Plant" fruit—"the crooked hooks cling fast to the beast's pastern, and away he goes with the diabolical trap sticking to his foot, limping, limping ever till he has trodden the tough capsule to pieces and poached the seeds into the ground. I keep a few of these contrivances at the herbarium to show benevolent optimists who think this the best of possible worlds, and to make them reconsider their easy-going theories". In *Emex centropodium* (*Polygonaceae*) the "Duiveltjedoorn" (Pl. III. fig. 13.) the fruits are provided with three sharp spines; a very effective means of distribution.

Examples of plants with sticky fruits are found in *Plumbago spp.* (*Plumbagineae*) (Pl. III. fig. 11.) and in *Boerhaavia* (*Nyctagineae*) in the former case the persistent calyx is covered with glandular hairs while in the latter it is the fruit itself which is sticky.

4. Contraction of Certain Tissues of the Fruits or Seeds.

Several distinct methods may be recognised by which seeds are scattered by contraction or expansion of the plant tissue.

(a) Certain cells in the fruit or seed are in a state of tension and if suddenly released the fruits split and the seeds are violently ejected. Examples of these explosive fruits are found in *Impatiens, Barosma, Acanthaceae.* In some species of *Oxalis* it is not the fruit wall but part of the seed coat which takes an active part in opening the fruit. The cells of the seed swell considerably when ripe so much so that the fruit wall is split and a violent jerk is given to the enclosed seeds which fly through the rent.

(b) Certain tissues of the fruit become dessicated or dried up. In species of *Geranium* the fruits are one-seeded and the long style persists. When the seed is

ripe, the outer tissues of the style dry causing it to curl up rapidly which has the effect of violently ejecting the seed. In the allied genus *Pelargonium* the fruit is similar but the ovary is not split. When the 5 carpels are ripe they separate suddenly and are thrown some little distance from the plant.

(c) This class of fruit really belongs to the first section enumerated above, but as it is characteristic of many *Leguminosae* it can conveniently be considered by itself. In species of *Indigofera*, *Tephrosia*, *Crotalaria*, etc., the pod when ripe is in a state of tension and may suddenly burst, in doing so the two halves undergo a spiral tortion which is very rapid and results in the seeds being scattered. (Pl. III. fig. 8.)

The writer recently came across an interesting case of seed dispersal which appeared to combine various methods for securing this end. The plant is *Barleria thunbergiana* (*Acanthaceae*) Pl. III., figs. 3, 4, 5, 6, 7, and was found growing at Glen, in the Orange Free State. In habit the plant is prostrate; the fruiting inflorescence is about the size of a small hen's egg and of the same shape. The bracts of the inflorescence are spiny and it is quite conceivable that they could be carried away by adhering to the legs of sheep or cattle. When the inflorescence breaks up we find that each fruit is enclosed between two large membranous bracts which would enable the fruits to be scattered over the veld by the wind away from the place where the inflorescence fell to pieces. The fruits are hygroscopic and when they absorb water they suddenly explode expelling the seeds. Measurements made, showed that the seeds were scattered over a radius of at least 11 ft. Tightly covering the seeds are a number of long hairs which when wetted uncurl and stand out and thus attach the seed to the piece of ground which is wet and most suited to the germination of the seed.

Several such interesting examples will no doubt be met with in our flora when the subject of seed-dispersal receives more attention.

In studying the various adaptations met with in plants for the dispersal of seeds we cannot help noticing other facts which are of considerable interest. For instance in seeds and fruits which develop structures as a means to wind distribution, bright colours are rarely met with but they are usually dull green or brown. Also we often find that the same organ may serve two or more very different purposes. In species of *Polygala* the side sepals are brightly coloured and serve to attract pollinating insects, but in the fruit they lose the bright colour and then serve as wings for wind dispersal. The same dual purpose is seen in species of *Dombeya*, but here the petals after serving one function fade and are eventually utilised by the plant as a means of distributing its seeds by wind agency. Other cases which may be cited are *Leucadendron argenteum* (Silver tree) where the perianth, style, and stigma co-operate to form a mechanism for wind distribution; *Clematis brachiata* in which the feathery styles take part.

This short sketch is a very brief and general outline of some of the methods found in the South African flora for seed distribution. A detailed account of the mechanism found in any one plant or allied group of plants would possibly supply sufficient material for a separate paper, and it is hoped that such accounts will be forthcoming from Members in the future, and that the present article will be a stimulus to the further study of the subject.

My thanks are due to Miss S. I. Gower, of the Division of Botany, who prepared the accompanying plates.

Explanation of Figures.

Plate II.

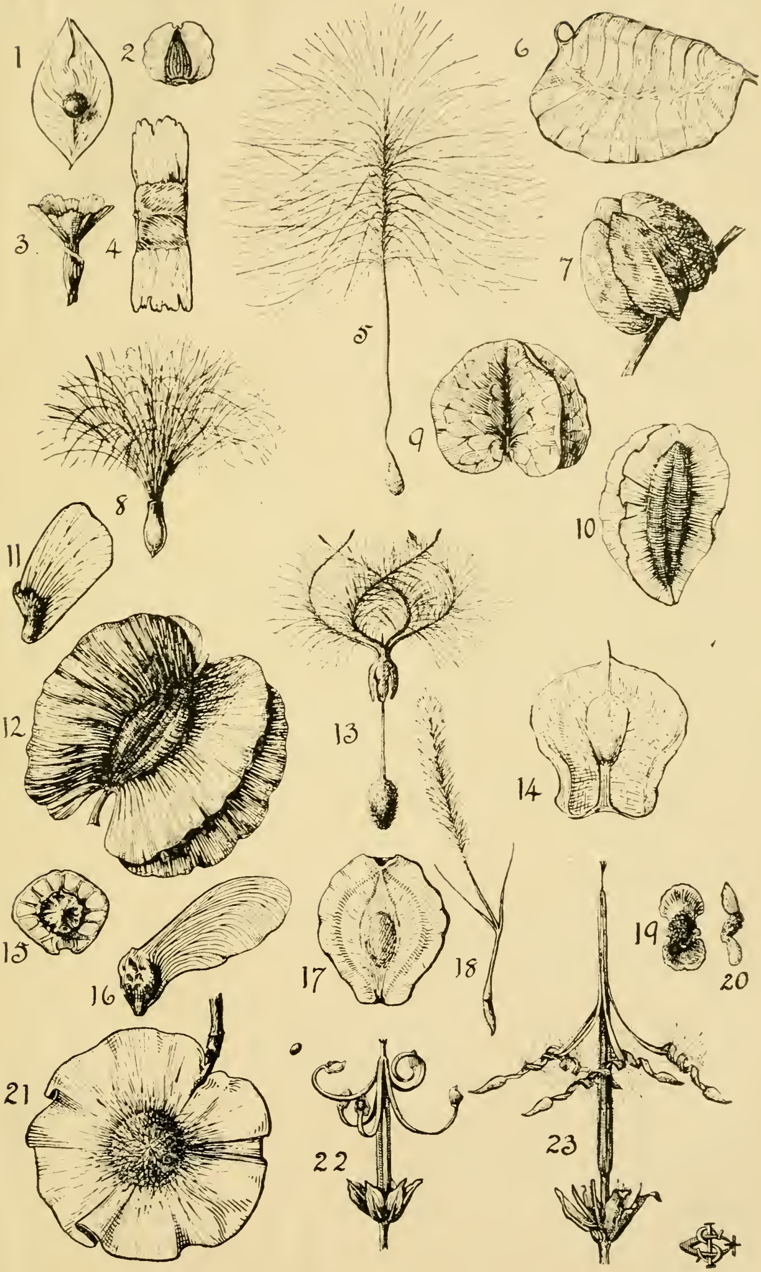
1. *Cardiospermum halicacabum* (seed attached to septum).

2. *Leucandendron sp.* (winged fruit).
3. *Statice purpurata* (fruit with enlarged and persistent calyx).
4. *Markhamia acuminata* (seed with two wings).
5. *Strophanthus speciosa* (seed with apical tuft of hairs).
6. *Cassia arachnoides* (flattened pod).
7. *Aitonia capensis* (inflated fruit).
9. *Emex sagittatus* (fruit with three wings).
10. *Tripteris glandulosa* (fruit with three wings).
11. *Sphedamnocarpus pruriens* (mericarp with a wing).
12. *Combretum Zeyheri* (4-winged fruit).
13. *Leucadendron plumosum* (fruit at end of style and persistent perianth above).
14. *Welwitschia mirabilis* (winged seed).
15. *Semonvillea fenestrata* (winged fruit).
16. *Securidaca longipedunculata* (mericarp with a wing).
17. *Dimorphotheca spectabilis* (winged fruit).
18. *Aristida uniplumis* (feathery glume).
19. *Sesanum sp.* (seed with two wings).
20. Same as 19, but side view.
21. *Pterocarpus angolensis* (fruit with well developed wing).
22. *Geranium incanum* (showing seed being thrown from fruit).
23. *Pelargonium sp.* (fruits splitting from central torus and twisting spirally).

PLATE III.

1. Fruit of *Urginea altissima* showing opening of fruit to allow the seeds to escape.
2. Fruit of *Pretrea zanguebarica* (side view).

3. *Barleria thunbergiana* (fruiting inflorescence).
4. *Barleria thunbergiana* (fruit enclosed between two bracts).
5. *Barleria thunbergiana* (one half of capsule after fruit has exploded).
6. *Barleria thunbergianna* (seed tightly enveloped with long hairs).
7. *Barleria thunbergiana* (seed with hairs erect after wetting).
8. *Indigofera sp.* (showing one valve of pod with a spiral twist).
9. *Tagetes minuta* (fruit with 2 spines as a pappus).
10. *Eriospermum Burchellii* (seed covered with long woolly hairs).
11. *Plumbago capensis* (calyx with glandular hairs).
12. *Eulophia laxiflora* (fruit splitting to allow dust-like seeds to escape).
13. *Emex centropodium* (fruit with three spines).
14. *Harpagophytum procumbens* (fruit).
15. *Limeum linifolium* (fruit).
16. *Arctopus echinatus* (spiny involucre).
17. *Arctopus echinatus* (fruit).
18. *Triumfetta sp.* (fruit with barbed spines).
19. *Pupalia lappacea* (fruit enclosed in bracts covered with hooked spines).
20. *Pretrea zanguebarica* (showing position of fruit with spines erect).
21. *Martynia lutea* (fruit with two recurved spines).
22. *Cyathula globulifera* (fruit enclosed in sharp pointed bracts).
23. *Pycnostachys reticulata* (4 nutlets enclosed in calyx with sharp pointed lobes).
24. *Triumfetta sp.* (fruit with simple spines).
25. *Erythrina acanthocarpa* (pod covered with spines).
26. *Aristida congesta* (spiny glumes).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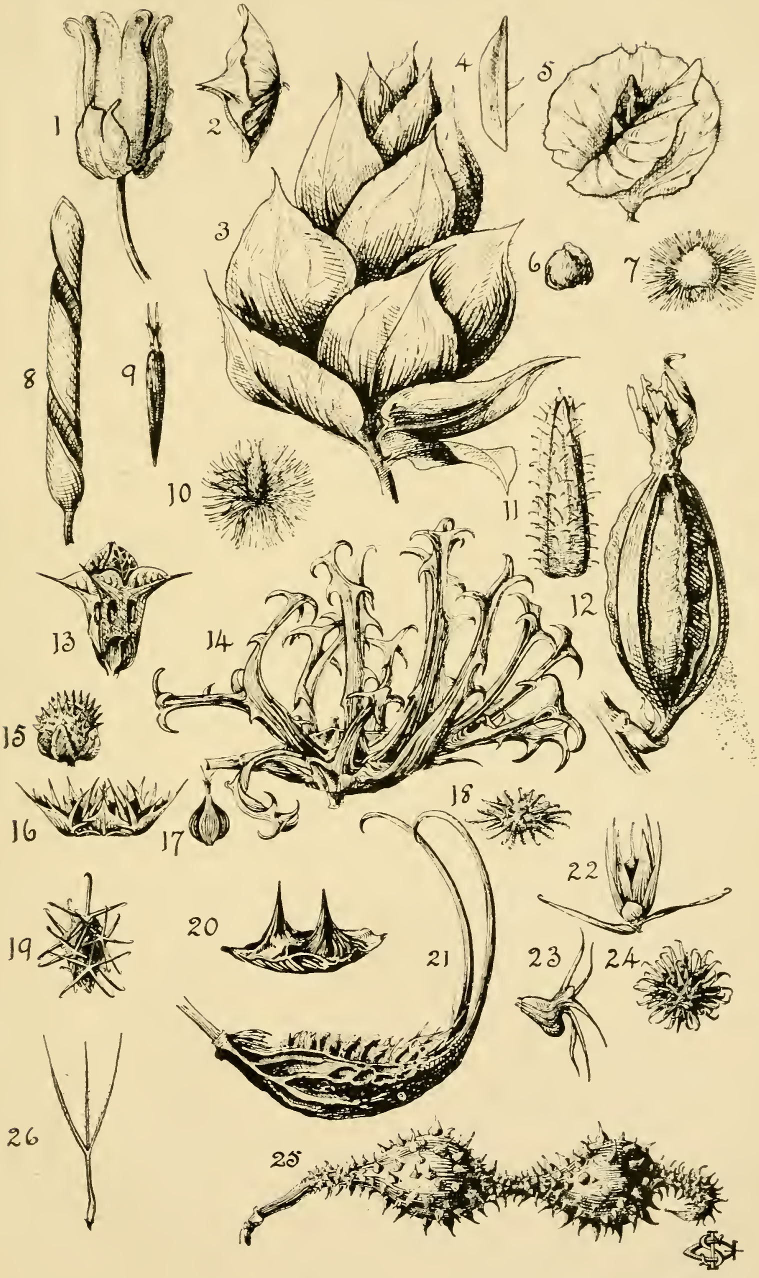
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Bird Life in the Drakensberg Mountains.

THE BLACK EAGLE (*Aquila verreauxi*).

By R. E. Symons.

The Black Eagle is the noblest and one of the most powerful birds in the Drakensberg, although considerably smaller than the Lammergeyer. It is distinctly a mountain loving bird, and is fairly common all through the Drakensberg Mountains both in Natal and Basutoland, but its stronghold on the Natal side is undoubtedly the head of the Little Tugela near Champagne Castle. The grandeur and beauty of the scenery here is beyond description, and hardly to be surpassed either in or out of Natal. Standing on the Little Tugela-Bushman's River watershed, one has a magnificent and awe-inspiring view of the Drakensberg Mountains, where the numerous tributaries of the Little Tugela have their source. Pinnacle after pinnacle, buttress after buttress, tower hundreds of feet into the air, with here and there some huge cleft in the mountain, and dark mysterious looking gorge. Down the face of one of the highest krantzes in the mountain, what appears to be a silver streak is seen, but in reality it is the main tributary of the Little Tugela, which rises at the very summit of the Drakensberg almost in Basutoland, and comes tumbling down into Natal, over a sheer drop of 800 feet. Turning from the mountains one sees far below the Little Tugela winding its way through the Little Berg, where there are more terrific krantzes. It is here that the Black eagle may be seen almost any day, and where he appears at his best, a noble bird in a grand and beautiful home. Who can fail to feel a thrill of admiration, on seeing him

soaring majestically high above the cliffs and crags of his mountain home, or swooping at lightning velocity after his prey, and again he may be seen seated high up on some dizzy pinnacle, truly a "monarch of all he surveys".

The Black Eagle lives chiefly on rock-rabbits, hence the name Dassievanger of the Boers, which are exceedingly plentiful in the mountains. Unfortunately, however, he is rather fond of taking young goats and lambs, and while in charge of the Giant's Castle Game Reserve, natives often complained to me of the depredations of these birds, and begged me to shoot them. They also destroy a good deal of game every year, especially oribi and rhebuck. While at the Little Tugela I once saw an eagle swoop down three or four times on to a full grown vaal rhebuck; the animal was feeding on a very steep hillside just above a krantz, and every time the huge bird came down on to the unfortunate buck's back, it would bound forward and so was in imminent danger of going over the krantz. Whether the bird was really trying to kill the animal I cannot say, but it certainly appeared to be in earnest. Black Eagles are also very partial to baboons, and on one occasion while after a troop of baboons with my brother, high up on the slopes of the Drakensberg, an eagle came swooping down from an immense height and seized a half grown baboon, which act, raised a tremendous chorus of disapproval from the other members of the troop. When some distance up in the air, the unfortunate baboon was seen tumbling down; whether the eagle had released its victim purposely, or that the animals struggles had caused it to do so, I cannot say; the bird made no attempt to follow it up again but flew off. Again in the Little Tugela Valley, an eagle was seen to attack a troop of baboons which were feeding on a ridge, but before the bird could pick out one of the numerous young ones, the whole troop had made off at a great pace for the

nearest tree where the young took cover, while the males and large females stood in a circle round the tree and so prevented the eagle from getting at their young. I have never seen, or heard of, an eagle attacking a full grown baboon, but they undoubtedly take the young whenever they get a favourable opportunity. The appearance of a Black Eagle causes a tremendous outrcy and commotion amongst a troop of baboons, the hoarse bark of the male mingling with the shrill screams of the females and their young, as they make for cover. Rabbits and hares are also taken by the eagle when opportunity offers, the former being fairly plentiful in the Drakensberg. I have not heard of partridge or other birds being taken, but where the smaller mammals are not so plentiful they would probably take to killing birds.

The Black Eagle is a fairly silent bird, and unlike the Bateleur or Sea Eagle, it is not often heard calling, although I have occasionally heard its shrill cry, usually when the bird is flying at an immense height. The cry is not unlike that of Buteo jakal, only if anything a little sharper.

The nest of the Black Eagle is genearlly built high up in some inaccessible krantz, and I have not heard of anyone yet being able to take the eggs of this bird on the Natal side of the Drakensberg. I once found a nest in the Little Tugela Valley, situated in a krantz about 400 feet sheer drop; half way up, a bush or strong shrub was growing out of a crevice or cleft in the krantz, and on this bush a pair of eagles had built their huge nest of sticks, lined with grass. By climbing to the top of the cliff one could see down into the nest, and with the aid of field glasses the contents could be seen quite clearly. The first time I examined the nest it contained one which looked like a white ball of fluff. This pair of eagles had been doing a good deal of damage to native herds of goats and sheep, feeding on the slopes of the Little Berg, so that I made up my mind to destroy them

together with the young one in the nest. I took up a position at the foot of the krantz, in full view of the nest, and waited. It was some time before I could get a favourable shot; eventually, however, one of the birds sat on the edge of the nest, and at my shot fell dead into the nest alongside the young one. The mate of the dead bird was seen in the vicinity of the nest on the following day; it then disappeared for some time, to return in a day or two with a mate, and both birds were seen at the nest, but whether the young one was still alive I could not tell although the birds certainly appared to be feeding it.

On June 1st. 1912, I again visited this nest and found that it contained two eggs, which could be very clearly seen from the top with field-glasses; they were white covered with reddish brown blotches. One of the birds was shot while sitting on the edge of the nest, this time from the top, and it fell down to the bottom of the krantz, where on the following day it was recovered. The remaining bird on missing its mate went off in search of another and a few days later two birds were seen at the nest. In 1914 one of a pair of eagles was destroyed at the Little Tugela and the remaining bird soon returned with another mate; but a few days later, one of these was killed, whether the old one or not I cannot say, when also the remaining bird did not take long to find another mate. In fact, once a pair of Black Eagles have chosen a nesting site, it seems as if nothing will drive them away from the spot; as soon as one bird is killed, another will be found to take its place.

In Basutoland, these birds are quite common, and I know of several pairs breeding there, one in a krantz opposite the Mkhotlong Police Camp, not far from the junction of the Mkhotlong river with the Orange. This nest is not in such an inaccessible krantz as most of the others I have seen, and Mr. Petherbridge, of Polela, Natal, who succeeded in getting down to it with the aid of a

rope, found a young Black Eagle, which he took home with him, as far as I know, it did well in captivity. The birds returned to this nest again the following year, and when I visited it, in September 1915, it contained a young one, which was afterwards killed by Basutos. The other pair was breeding in the Sanqebetu Valley about ten miles from the Natal-Basutoland border. There were three nests here, two of them being old, and from subsequent observations it is obvious that the birds keep changing their quarters; although, as a rule, they will return to the same nest year after year, after repairing it thoroughly each season, and even when the young have been hatched, the parents may often be seen carrying sticks to their home, evidently keeping it in repair so that when their precious offspring become older and more restless they will not fall out. I was once misled by seeing an eagle carrying sticks to the nest; I made sure that the eggs had not been laid, but I found out a day or two later that the nest contained an almost fully fledged young one. In the Sanqebetu Valley the Basuto herd boys, by climbing to the top of the cliff, were able to get within stone's throw of the eagle's nest and they used to destroy the young ones nearly every year, as the old birds took off so many of their lambs. With a good stout rope, I think that it might have been possible to get the eggs from this nest, although it would be a very difficult and hazardous undertaking.

The eggs of the Black Eagle are laid in June or July; as already mentioned, the nest found in the Little Tugela contained eggs on the 1st June 1912, and a pair of eggs in the Millar Collection, in the Durban Museum, were taken on the 16th July, 1897, in the Swartberg Mountains Cape Colony. These are described as being "ovate" in form, the ground colour being pale cream, covered with blotches and spots of reddish and purplish brown; they measure 3.1 by 2.37, and 3 by 2.38 inches, respectively.

The plumage of the adult bird is black, with the lower part of the back and rump pure white; this white patch is very plainly discernable when the bird is flying, unless of course it is directly overhead. Length about $2\frac{3}{4}$ feet; and the average length from tip to tip of the wings when spread is six feet six inches. A female shot by me in the Bushman's River Valley measured over seven feet from tip to tip of the wings, and was 29″ in length. This bird has been set up and is now in the Natal Museum, Maritzburg; it was in immature plumage.

In conclusion I may mention an interesting but probably little known fact in connection with the Black Eagle, i.e. its habit of playing in the air. Flying to a great height, the eagle will suddenly close its wings and drop like a stone for a few feet; then turning over and over like a tumbler pigeon, will eventually when fairly close to the ground, open out its wings and swoop gracefully away to repeat the performance in some other part of the mountains.

The Trout in South African Waters.

By Arthur H. Reid.

Very little attention appears to have been given to the biologics of our South African Rivers and Lakes. It therefore affords me much pleasure to accept Dr. Phillips' offer of space in our Journal, in the hope that a short resumé of many years study of non-indigenous fish life, may create an interest in the subject and be of service, if merely as a guide, to those sportsmen naturalists who are members of our Society.

Perhaps I cannot better preface my remarks than by stating that the conclusions submitted are not mere sur-

mise, but are founded upon the result of scientific research conducted by myself in the life history and habits of Brown and Rainbow Trout in South African waters. The chief points covered by the work have been recorded under the following heads:—

1. Date of observation.
2. Name of river.
3. Locality of river.
4. Altitude above sea level.
5. Time of observation.
6. Sky aspect.
7. Cloud aspect.
8. Direction of wind.
9. Power of wind.
10. Barometrical reading.
11. Thermometrical readings in sun, shade and water.
12. Condition and volume of water.
13. Date of last rain.
14. Hours when fish were rising.
15. Flies and insects on and in the water.
16. Number and description of fish killed, kept, and returned and reason for the return.
17. Description, classification and condition of fish.
18. Weight of fish killed.
19. Contents of stomachs.
20. Altitude of flight of Swallows and Martins.

Life History of the Trout.

The only members of the family Salmonidae that have been acclimatised in South African waters are the Brown, Rainbow, and Loch Leven varieties. The first attempt was made by a Syndicate in the Eastern Province of Cape Colony, to which the author was a subscriber, in 1881. To Mr. J. D. Ellis of Kingwilliamstown must be credited the inception of the idea, and the first shipment of ova arrived in 1885, but the experiment was a failure.

Another attempt by Mr. J. C. Parker of Pietermaritzberg, Natal, also failed. In 1884 Mr. Lachlan Maclean took the matter up again with some friends at Cape Town, when ova were imported and hatched at Ceres Road. They did well for a time, but through an accident the bulk of them perished. A few, however, were placed in the Dwaars River, Mitchell's Pass, a Tributary of the Breede River, and some in a pond on the Waverley Mills Estate. Both did well, but those in the pond eventually perished through the water becoming overheated. Sufficient experience had, however, been gained to prove that the acclimatisation of trout was possible and another attempt on a larger scale was made in 1890-91, when the Colonial Secretary (the late Mr. J. W Sauer) induced the Government to assist financially and otherwise. In 1892 a further shipment of ova was sent from England, but was not the success it should have been. Another was sent, which was dealt with in proper ponds at Jonker's Hoek, Stellenbosch, by the courtesy of the late Mr. F. G. Watermeyer and was so completely successful that numerous rivers were stocked and have been self supporting ever since. To the Eerste River at Stellenbosch must go the honour of being the first to be stocked, but of late years quite a lot of eligible rivers and streams have received attention.

Brown Trout.

The Brown Trout (*Salmo fario*) is generally believed to be non-migratory. Those that are bred and remain in the smaller streams seldom grow to a great size, and in England a brook trout of a quarter pound would be considered large, though in the greater rivers and lakes they run up to 10 lbs. and more. Much depends upon the food supply of the waters they occupy. The Brown Trout is of a colour varying from olive green to brown with red and black spots on the sides, back, and occasionally to

the dorsal fin. Sometimes they have a great preponderance of black spots with very few red, others assume a beautiful yellow, almost golden colour, as in the White River, Mitchell's Pass, Ceres, and others a very dark brown, almost black. The variations are in correspondence with natural peculiarities of their daily surroundings and food, the colour of the sand, stones or weeds in the bottom or sides of the river, the clarity of the water. exposure to sunshine, etc. The Brown Trout prefers speedy, clean, broken water and is a past master in selecting quiet, sheltered spots where he can lie and watch for his prey. During the day the larger fish remain in their haunts but at evening and during the night they roam about in search of food.

When the spawning season arrives the lower jaw of the old males elongates upwards, as does that of the salmon, but not to the same degree. From observations and careful autopsies covering some years before and after the spawning season, the author believes that when some females are over carrying their spawn others have none. The process of fecundating the eggs is very interesting, and can be seen from the road bridge in Ceres village during July. The female makes a depression in the gravel of the river bed with her tail by a sweeping movement and ejects the ova into it; afterwards the male fertilises the mass of ova by emitting and covering it with the milt.

The operation takes about a week to complete. The female usually discharges all her ova in a day, but the male takes about six days to liquify and discharge his milt. During those days the fish jealously guard their deposit, the cock fish chasing away any other that may be approaching his preserve. They then cover the deposit with gravel by sweeping it with their tails and leave the rest to Nature and Chance. After a rest in the gravel as already described, two small black spots develop in the embryo. These are the future eyes of the fish and

the eggs are known as eyed ova. Then, after lying with the running water continually washing the deposit for about 6 weeks, the youngsters bore their way through the shells of the ova and freeing themselves become alevins, each with the yoke of the egg hanging from its underpart like a sac or bag. They remain in this state, in the gravel, from three to six weeks according to the temperature of the water, obtaining nourishment by absorbing the contents of the yolk-sac; when that is exhausted they free themselves from the gravel and appear as minute fish about $1\frac{1}{4}''$ long, seeking food for themselves.

The same process applies to all varieties of trout, and it has been suggested, that hybridization is taking place between the Browns and Rainbows naturally. There is no absolute proof, but specimens have been killed bearing such peculiar colourings and markings that the possibility has naturally suggested itself.

Loch Leven Trout.

The Loch Leven Trout sometimes known as (*Salmo levensis*) has generally a more silvery colouration of the belly than has the Brown, fewer or no red spots, and the flesh is pinkish rather than yellowish red as in the Brown Trout. They seem to have disappeared from the Lowrens River where they were placed or probably they have been transformed into the Brown variety, for the Loch Leven trout is merely a variety of the species *S. fario.*

Rainbow Trout.

The Rainbow Trout (*Salmo Irideus*) of North America has increased more than any other variety in our waters, probably due to the fact that water of a high temperature does not affect them seriously as it does the *S. fario.* The upper part of the body is of a blueish or purple hue

varying from gold to silver below, profusely covered with black spots which extend over the dorsal and caudal fins and with a bright red lateral band. The beautiful red lateral rays increase in brilliancy as the spawning season approaches and are much affected by the tone of the surroundings and by excitement. The Rainbow Trout is far more hardy and more capable of accomodating itself to various surroundings than the Brown. They seem comfortable in comparatively stagnant water and love a romp in the swiftest flow. The author has killed a few in the lower waters of the Eerste River that were silvery all over, like fresh run spring salmon, and devoid of spots. These had evidently been to the sea or estuary and it is well known that many have been taken by the fisherman's nets in False Bay and offered for sale at Somerset Strand. They vary very much in the display of the rainbow rays and are more susceptible to the influence of colour around them than the Brown Trout. In deep pools surrounded by black earth, the author has killed specimens as black as the earth from head to tail, with a mere vestige of dull silver on their bellies. They can exist in water of a higher temperature than the Brown Trout and are therefore more suitable for certain of our rivers. It is to be hoped that the migration of trout to the sea and elsewhere will receive due attention from those who have the leisure to study their habits. They probably go to the sea with the first flood, say in April or May, and return to spawn the following year. The usual spawning season for Rainbows in Cape waters is in June or July, and of the Brown in May or June, but in each river they vary surprisingly and the presence of snow water from the mountains must influence the congregation of both varieties at the junction of the tributary streams with the main rivers. Judging from the number of female Rainbows that are burdened with ova carried over from the past season, it seems possible that a continuously hot

summer without rain induces congestion of the ovary and of the ova.

It seems to be an established fact, that the farther the fish have to travel to their "redds", the shorter is the time devoted to the operation of spawning and that in the sluggish streams considerably more time is required than in the faster. Unless all the spawners arrive together, there is always the danger of late arrivals disturbing and wrecking the deposits of the earlier. In such a case, too, there is the probability of the earlier hatched fry harassing the later and smaller. Nature for some reason or other ordains that they shall crowd together in the quietest and shallowest waters while they are very small.

The period of incubation depends almost entirely on the temperature of the water and varies greatly. At a temperature of 40 degrees Fahr. the ova may be hatched in about 90 to 100 days, but in streams of higher temperature the process is accelerated to 30 or 40 days. The advantages of artificial incubation are, that the water temperature can be regulated to overcome the natural irregularities, a more perfect fertilization can be secured, there is little or no wastage of ova, and judicious selection of the ova, alevins and fry ensures a hardy stock. By the selection of ova and milt from healthy spawners the breed can be improved. Deformation of the fry under pressure or abrasion of the ova or alevins by gravel particles in the "redds" is excluded in artificial incubation. Under natural conditions it is reckoned that only about 8 per cent. of the ova are fertilized whereas under artificial incubation very few are missed. Then again after natural incubation alevins herd together, packed against stones in hundreds and are the wholesale victims of every predatory creature that exists. Perhaps their worst enemy is the duck, wild or domesticated; others are wagtails, sandsnipe, kingfishers, eels, crabs and the larger trout. Those that are left to become

"fry" are the prey of herons, cormorants, hammerkops, the larger kingfishers, otters, muis honds, large trout, etc. If suitable spawning beds are not provided in the upper waters, or if impediments to the migration of spawning fish are not removed, the fish must spawn on the most comfortable material they can find in the lower waters; and if in water near the pools, the fry are more or less promptly devoured, especially in rivers running low when food is scarce, becoming the prey of the larger and hungry fish.

The fry in our rivers seem to drop down to the deeper waters from their nurseries after the first rains between March and May of the year following their birth, so, as the spawning season for Brown Trout is generally from May to June and for Rainbows from June to July, they remain in their upstream home from 10 to 12 months. The author has found Trout in spawn and milt more or less developed as follows:—

Brown Trout in Upper Berg and Wemmer's Hoek, October and November.

Rainbows in Berg and Dwaars Rivers, October.

Rainbows in Eerste River, October, November and December.

Rainbows in Lowrens River, April and October.

Rainbows in Hex River, November.

When natural spawning beds do not exist, they can be easily made by cutting channels from 4 to 6 feet wide, parallel with the course of the stream, and covering their bottom to a depth of 12 to 18 inches with pea-sized gravel. The stream can then be diverted over these beds and can by simple sluices at each end be controlled so as to afford protection to the alevins from floods. Of course the water in these channels must be allowed to return to the stream lower down. By opening the sluices before the spawning season a full flow of water can be turned over the "redds", and the fish can be safely left to find their way to them in due course. Such an arrangement

enables those interested to examine and repair the gravel beds in the off season, and to personally supervise and protect the alevins from their land and air enemies by covering the channels with wire netting. In due course the sluices can be opened and the fry will scatter in search of food and shelter. As a rule they seem to prefer rather rapid and shallow water to that which is sluggish. Their food by selection is molluscs and fly larvae from under stones, water fleas, and other crustaceans. But their struggle for existence is a hard one in view of the many enemies that await them and of the fact that our streams, unless they are open to back waters or swamps, do not provide sufficient aquatic life, for winter floods devastate their banks and remove the vegetation upon which the fly larvae exist. It is very interesting to watch the fry working their way downstream on their first journey. They seem to be all on the "qui vive" and continually plucking or eating something when they stop to have a rest. They travel in short stages with their tails first and heads upstream so that the flow of water carries them down, but directly they strike slow or stagnant water they bolt off with their heads downstream until they pull up behind a stone or some other shelter and have a rest. In some waters however the passage is a perilous one, as the big fish wait for them in the main river.

Food Supply.

Backwaters and swamps are the breeding grounds of just those forms of aquatic life that provide the most desirable food for trout, and there are many such quite close to our rivers that could be easily connected thereto by simple channels. Then again many irrigation furrows could be converted into excellent food waters for fry by judicious widening and weed planting: wire screening could be arranged to prevent bigger fish from

passing up the furrows. An important point to note is that the water levels vary very much during the season, being in the driest months very low, and when the fish need food there is little for them. Trout need a constant supply of food or they will prey upon the smaller fish, including their own fry. Now, if the bogs and backwaters before alluded to were connected by channels with the rivers, they would yield a supply of vegetation and aquatic life which would in many cases keep the river beds supplied all the year round, because it would be washed out and deposited annually along the banks and in pools with accompanying soil and sediment. Indeed, a little attention would disclose hundreds of corners which would hold vegetation with the accompanying living organisms that are so badly needed, and which, but for the vegetation, would be washed away by every flood. Where pools have a soft bottom it has become so by the deposit of alluvial matter, which proves that in times of flood that particular spot is more or less free from scour and should be a suitable centre for the propagation of aquatic plants to provide food and shelter for the fish; of course it is necessary to select the proper plants. Such beds should only be formed where, in the driest season, there is a slight inflow and outgo of water and preferably in places somewhat exposed to the prevalent winds, which ruffle the surface. By that action the water naturally absorbs the necessary amount of oxygen to keep it fresh and sweet. Such a pool should not be too much sheltered by trees as a certain amount of sunlight is necessary for the growth of plants and is beneficial to the fish. Unless a proper exposure to light and wind is provided to stagnant pools, there is always the danger of trout being attacked by the Salmon Fungus (*Saprolegnia*) or some similar disease. As stated elsewhere, I have unfortunately good reason for suspecting the presence of some such disease in certain waters. It is believed that the disease is not necessarily epidemic, but

under certain conditions is likely to appear upon fish that have been wounded. Those that migrate to the sea or to brak estuaries soon free themselves from the malady, but those that are affected and remain should be destroyed and their stagnant haunts converted into running water by the removal of all obstacles. In the case of head waters that are deficient in food, a little pond here and there with channels to connect them to the stream would yield an enormous amount of fish food, and if made near a homestead improve the landscape. Then again water cress planted in the streams and furrows would be of service to man as well as fish, but in a compound scale to the former. I would impress upon all interested persons that by cultivating the growth of aquatic plants in the upper waters the floods would keep the lower portions going to a great extent, and by providing food for the fry in the upper waters they would remain there, instead of dropping downstream in search of food, to be snapped up by enemies and larger fish.

The severe floods of 1917 wrecked the banks of the Hex, Dwaars and Lowrens Rivers, carrying away all vegetation, roots and aquatic plants that provided insect and other forms of natural food for the fish; and the absence of fly on the rivers this year is evidence of the need for immediate action. The larvae of many insects exist solely on the plants and weeds that grow beside rivers, and as Nature is not replacing those that were washed away, it is the duty of those interested to expedite that work. The author has planted Willow Moss in the upper waters of the Lowrens at Somerset West, and as a stock is on hand at the Jonker's Hoek Hatchery, it is hoped some will be distributed and arrangements made to get it planted where it cannot be washed away by the winter floods.

The result of many autopsies covering many years enables me to record the following as items of the menu of the trout. centipedes, flying ants, caterpillars, flies, beetles,

larvae, water bugs, grasshoppers, spiders, crabs, caddis, mussel shells, pupae, frogs, trout and other fry, chunks of meat, green weed, grains of barley, seeds, skeleton leaf, poplar coronae and twigs, poplar catkins, husks of acorns and feathers: of which the most important are *crabs*, *flies* and *grasshoppers*. Not a bad selection? On 1st. October, 1917, in the Hex River, I killed a trout that contained 2 or 3 small fish. On 6th October, 1917, I killed a trout in the Berg River containing one small fish and on 2nd. October, 1915, in the Eerste a trout only 10″ long, containing two or three undoubted trout fry.

Division of Sexes.

Experience has led me to believe that there is a preponderance of female fish in our waters and that such is dangerously on the increase. There can be no doubt, I think, that in the early season the lusty vigorous young male fish fall victims to the rapacity of their seniors and of angers to a much greater degree than the more modest and circumspect females. It therefore seems necessary in the course of artificial incubation to place a preponderance of male fish into our rivers, for otherwise old and worthless males may take the place of the younger fish in the spawning beds with a resultant decline in the quality of the output. On the assumption, that a male fish is only of service to one female in particular, the necessity of balancing the numbers of the sexes is paramount. From 3 to 6 years seems to be the limit of age for the useful breeding of trout, especially of the males, and after that age they become bottom feeders, cannibals, bullies and all that is bad. They should be destroyed at all costs and by any means.

Selection of Stock Fish.

I have for some time watched the habits of trout in waters that have been stocked with both Rainbows and Browns, and have come to the conclusion that it is a

mistake to have both in the same water. Their habits, nature and temperament are so divergant that they should not be in contact. The Brown trout should be preferred for rivers that have their sources in mountains that are snowclad in winter; such rivers have as a rule speedy water, on account of the greater fall in their beds, and the water is naturally cooler on account of the altitude of the head waters above sea level. In other words, rivers whose sources are a great distance from the sea are better suited to Browns than Rainbows. The latter can withstand temperatures better than the former and are therefore more suitable for rivers of short length, with little fall and consequently much sluggish water, though of course they would thrive in the Brown trout water. Indiscriminate stocking must depreciate the whole breed and it is far better to ascertain the most suitable variety for any given water and stick to that, doing all that is possible to improve that particular breed and to remove all chance of contact with others. There can be no doubt that success or failure depends upon the condition of the water and the presence of plenteous and suitable food. The matter of food can be easily determined, both as regards the quantity available and the quality, by a frequent examination of the contents of the stomachs of the fish month by month, week by week and day by day if possible. The favourite food will soon be discovered, also if it is plentiful at every or any particular season. If at any time there is a shortage, it can be dealt with by cultivation, at the right season, of the proper animal or plant life. Regarding the existence of large predatory fish, the only remedy is their prompt removal. The Rainbow becomes cannibalistic much sooner than the Brown trout, probably as 3 years is to 5, and it is not difficult to ascertain their existence if they are seen in the water and not seen to rise. Rainbows are so voracious that they quickly consume all available food in one section of a river and then move on to another, giving the

Brown trout small chance of existence. It is noticealbe in some seasons how trout rise freely for some time and then suddenly stop altogether for the rest of the season. This is probably due to the production of some form of bottom food in large quantities. It can be easily proved by frequent autopsies and if the habit becomes general and incessant the only remedy is to increase the stock of fish and thus, by the exhaustion of the bottom source of food supply, induce surface feeding.

The temperature of our river waters has a very important bearing on the fish and plant life. The highest water temperature ever experienced by the author was at Ceres, being 83° Fahrenheit in still water at the surface and 82° in running water. Needless to say no fish could survive such a temperature and as no dead ones could be found it is presumed they sought cooler water at the bottom of deep pools or migrated to the cooler head waters. On 10th January, 1917, in the weir pool at Vergenoeg (Faure), I found the surface water temperature to be 80° Fahr. and saw six trout from two to three pounds and twenty ranging from 12″ to 9″ long on the move, to and fro, in the pool below the weir. Above the weir boards about 12 trouts running from 14″ to 9″ long were hanging against the upstream side of the boards with the water passing over them. As I stood in the water on the weir, on the upstream side of the boards, many fish passed and re-passed within a few inches of my legs, without apparently noticing my presence. They all seemed languid though restless. Two swam into shallow water so near to me that I could have taken them in my landing net or kicked them out of the water. Later on some rubbed against my legs and continued doing so until I moved, when they swam slowly away. Some had their backs out of the water, others moved listlessly about among the reeds on the bank. Many were Brown trout and they varied very much in colour. Two appeared to have fungoidal growths on their backs. On the whole the

fish were in fair condition, but a few were poor and weak. Flies were offered, but without avail. On walking into the entrance of the irrigation furrow above the weir, several good fish brushed over my feet quite leisurely. All the above occurred at 4.30. p.m. Wind W.S.W. Barometer reading 32.00 at about 15 feet above sea level. Thermometer 76° Fahr. in the shade and 97 in the sun and 80° in the water.

From statistics prepared during many years experience, the writer has found that the average number of fish killed or returned per day under various conditions of temperature is as follows:—

From 16 to 13 fish per day. Water temperature 58° to 62°.

From 10 to 12 fish per day. Water temperature 58° to 72°.

From 6 to 8 fish per day. Water temperature 60° to 75.

From 0 to 5 fish per day. Water temperature 62° to 80°.

Habits of Trout.

It may be observed that as the season advances the fish are inclined to migrate from spot to spot. Pools and quiet runs that afford excellent sport in October will draw blank in January. Many reasons are advanced for this movement elsewhere in this treatise. Perhaps one is that some fish may not have recovered their condition after spawning as others have in October. There is little doubt that sometimes trout after a good meal retire to deep pools or shaded nooks until they have digested their food. At other times their presence under trees or bushes is due, I think, to the fall of insects from these trees when disturbed by the wind. This may also account for the congregation of fish at times, at the junction of streams with the main river. Spawned fish naturally avoid broken water and exertion for a time and

seek the bottom of deep pools to rest and feed upon what comes along, but after recuperation occasionally the most vigorous and best conditioned trout are found in speedy riotous water even when the temperature of the water is high. This may arise from the fact that running water is cooler on the surface than that which is stagnant, as well as more highly oxygenated and stimulating to the fish. Perhaps also the habit of lying about in shallow water running over a pebbly bottom in bright sunshine is nature's antidote to parasitic growths which are known to develop when the water gets low. Any interference with the natural conditions of trout water requires the most careful and expert consideration, for there is an interdependence between every type of living organism in water, as on land, and any interference may disorganize the whole system. We are now beginning to hear that fishing is falling off in certain waters, that the fish are in poor condition here and very small there. This arises from a lack of knowledge on the part of those who stocked the waters, and of those who supervise or do not supervise. The mere addition of a few thousand alevins or fry per annum to a river, coupled with very occasional or no protection against illegal capture is of no avail unless the natural resources of the water be developed to secure the regular feeding and protection of the stock. Everything must not be left to nature if our rivers are to be properly and economically developed and main tained. Experience teaches that every river should be treated as a whole by a central Conservancy Board or Association and not divided up into sections, each of which is subject to the whim, care or neglect of riparian owners.

It is a mere waste of time, energy and money to deal with one section of a river unless control is secured over the waters below and above the section. It is useless to remove vermin in one section if they find sanctuary in the next, and it is not fair that the stock placed in one

section should be attracted to or destroyed by the neglect or intent of an adjoining neighbour. It is well known that those portions of a river where trout spawn are not favoured by them as a habitat during the rest of the year, and this is probably one of nature's means of protecting the new fry from the depredations of the mature fish. Trout would probably be hatched in one section, developed in another, to spend their years of maturity in a third, migrating each year to spawn in the first. There are few rivers that afford spawning, rearing and feeding grounds within reasonable distance of each other, and it is well so, as such rivers provide but a poor prospect for the small fish. Generally speaking the spawning beds are situated far up in the high waters or in tributary streams which afford suitable gravelly beds and are too small for the sustenance or comfort of large fish. Up to the present our South African head waters have the advantage of being unpolluted, having clean gravel beds, which is most important, as mud in the gravel prevents the free percolation of the water, fouls the outer shell of the eggs and may produce gases that kill an embryo so dependent on a plentiful supply of oxygen in it's development. As remarked elsewhere, the embryo remains in the gravel from 3 to 6 weeks, according to the temperature and the condition of the water, so it will be readily understood, how desirable it is to have an unrestricted flow of clean water through clean gravel. A healthy, well developed trout should shed about 800 eggs to the pound weight. Careful observation of the "redds" proves that a very large proportion of the naturally deposited eggs are injured by compression or abrasion by the gravel, especially if it be sharp.

Pollution Mortality.

The matter of the pollution of streams in the vicinity of towns, villages or factories is fast becoming one of

supreme importance. The Eerste River at Stellenbosch is perhaps the worst example. I have picked up 4 or 5 dead trout, each about one pound in weight, in one afternoon below Stellenbosch, whilst others were rolling about in a state of semi-asphixiation. In January, the river below the village is very low, and sometimes evil-smelling, as on the occasion above mentioned. The residue of Wineries and Distilleries, together with solid and liquid domestic refuse that had been cast into the town furrows, brought about the unusual mortality. This pollution has, to some extent, been dealt with by the Provincial authorities, and it is to be hoped will not be permitted to continue. The washing of brandy and wine casks and the throwing of wine refuse into the river is dangerous to fish life, especially when the river is low, for then the filth finds its way into the more or less sandy pools and is covered by the next flood with sand and other solids. The result is decomposition accompanied by the production of gas. When wading in these pools in summer, the pressure of one's feet liberates the gas, which rises in bubbles and is very offensive; in the same way cattle stir up the decaying filth, which is carried downstream to injure or kill any young fish or fish food that it may envelope. The mature fish are not so susceptible to the evil influence as the fry and when there is a reasonably copious flow of water in the river they can migrate and evade the nuisance. The extent of damage to the fish naturally depends upon the temperature of the water, which at say 40° Fahr. would be comparatively harmless, while at 80° it would be fatal.

Water Vermin.

The chief enemies of trout are named in the clause relating to spawning, but having watched the havoc wrought by cormorants in the Eerste River, in the Hex at Worcester, and in the lake at the Cape Explosive Works at Somerset West, it seems wise to devote a little space

to the subject, if only as a caution to those who are responsible for the supervision of stocked waters. The cormorant prefers mature fish to the smaller, and I have seen them chasing large trout under the banks on Mr. Faure's farm at Faure. My attention was first attracted by the flashing of fish in the dark water, as they darted away to avoid capture. I then saw a shadowy body swimming deep down in the pool against the overhanging bank. At first I thought it was an otter, so waited and watched, when a cormorant rose to the surface with a trout about 8″ long in it's beak. The damage done to trout by cormorants is inconceivable to any but those who know. Their appetites are insatiable, their cunning and activity in pursuit extraordinary, and their persistence equalled only by that of the ant. They are credited with digesting their own weight of fish per day. Their faculty for concealment above or below water is marvellous and the colour of their plumage favours them in that regard. Though they sometimes visit a water in numbers, as a rule they fish alone, and as they move about from place to place by night as well as day, they are difficult to locate. The Curator at Jonker's Hoek Hatchery (Mr. Chaplin) has on view the contents of the stomach of one cormorant that was only a few minutes in his carp pond before being shot, and it is certainly an object lesson to those who may have any doubts on the matter, being a 1 oz. bottle full of carp fry. Cormorants should be ruthlessly destroyed by all anglers and riparian owners. I submit that the habits of the cormorant cannot be defended and that the species should be severely dealt with without delay at all events on our inland waters and rivers. There is ample evidence that they have increased enormously in late years, that they are voracious feeders, that they devour enormous quantities of valuable fish that have been placed in the rivers at great expense, and that they do not destroy any other enemy of the fish. These facts can be easily proved by

autopsies of those that may be killed for the purpose. In Tasmania a reward of 1/- per head is paid by the Government or by the Angling Associations and both eggs and nests are destroyed.

Dr. Francis Ward estimates that a cormorant which weighs 6 to 8 lbs. consumes at least 15 lbs. of fish per diem and as an experiment he gave a captured cormorant as many herrings 7″ long as he could swallow. He put away 27 at one sitting!

Some Common Parasitic Worms Occurring in the Domesticated Animals in South Africa.

By E. M. Robinson.

Two common nematode worms occurring in the oesophagus of the ox, sheep and goat are *Gongylonema Scutatum* and *G. Verrucosum*. These are long thread-like filariae threaded under the mucous membrane and may occur in the pharynx, rumen and reticulum.

Spiroptera Megastoma is a small white nematode occurring in the stomach tumours of the fundus of the horse's stomach.

Spiroptera Microstoma closely resembles *S. Megastoma,* but is found in thousands in the stomach contents of the horse and never in the tumours of the stomach wall.

Amphistomum Conicum is a trematode worm found in clusters in the rumen, usually close to the entrance to the reticulum, in cattle, sheep and goats. It is about the size of a grain of wheat or a little larger, and is pink in colour. The intermediate stages in its life history are probably passed in a fresh water snail. A conicum is found in the reticulum as well, but never anywhere else, though in the buffalo a species is found in the coecum.

Haemonchus Contortus. This parasite, which is probably the most important one of stock in South Africa, occurs in the abomasum of sheep, cattle and goats. The female is about $1\frac{1}{2}$ inches long, and has a twisted appearance due to the intestine containing blood, winding round the oviduct which is not coloured, so that the appearance of a barbers pole is obtained. The male is about an inch long and is red in colour. The common name for the worm is "The Sheep Wire Worm".

The small intestine of cattle contains a minute hair like worm *Cooperia Oncophora,* which is very difficult to see in the bowel when opened. The sheep's intestine contains a similar small hair like worm, the *Trichostrongylus Instabilis,* a worm likely to be of much economic importance in the future. The small intestine of the horse contains a large nematode, *Ascaris Megalocephala,* which worm may reach a lenght of 15 inches in the female. The colour is yellow and the female is much larger than the male, as is usual in nematodes. The pig's intestine contains a closely allied worm, *Ascaris Suilla,* which is similar in shape but is whiter in colour, and does not usually attain a length of more than 8 inches.

The caecum and colon of the horse contain a host of different species of nematodes, and a tapeworm, *Taenia Perfoliata,* which is about $\frac{1}{2}$ to one inch long, leaf like in shape has no hooks on the head. There is a species of nematode found in the colon of the horse, *Oxyuris Curvula,* which is a white worm about 2″ long in the female, the only sex easily found, and tapers towards the tail end. The large intestine of sheep and cattle often contains a small round worm, *Trichocephalus Trichiuris.* This worm has the appearance of a stock whip, the head and a portion of the body being very thin and thread like, and the tail end is thick. The small intestine of the sheep usually cotains a nematode, *Bunostomum Trigonocephalus.* This worm is a blood sucker, is attached to the mucous membrane and has a well

developed tooth in the mouth portion. A similar worm occurs in cattle, *B. Phlebotomum,* and the two species are only distinguishable on fine morphological detail.

In the caecum and colon of sheep and cattle, nematode worms of the Oesophagostome species occur with great frequency, in fact are rarely absent. The adult worms are very white in colour, about $\frac{3}{4}''$ long, and twisted at the tail end usually. The larval form occurs in the intestinal wall forming small nodules containing a green cheesy material, and which later becomes calcareous. The sheep harbours *Oesophagostum Columbianum,* and cattle, *O. Radiatum.*

The dog's intestine contains several species of tape worm and two of round. Of the tapeworms, two are of great importance, *Taenia Echinococus* and *T. Marginata.* The former is a tiny armed tapeworm, about $\frac{1}{4}''$ long, and having only four segments. Its intermediate stage occurs in cattle, sheep and other animals, and produces large cysts in the liver, lungs, etc., causing the organs to be useless for food. *T. Marginata* has its intermediate stage in sheep and goats, and in buck as well, producing the well known bladder worms, known to every butcher. These jelly like bladders are attached to the omentum or mesentery, and may be present in large numbers. The most common round worm of the dog is *Ascaris Marginata,* a white worm about 2″ or more in length, often present in large numbers and producing fits and convulsions in puppies.

There are about 75 species of common parasitic worms found in the domesticated animals in South Africa and the list given only refers to some of the more common ones.

GENERAL NOTES.

The Flowering Plants of South Africa.

We note with pleasure the preliminary announcement of Vol. I. No. 1 of "The Flowering Plants of South Africa" which will be published in November of this year.

This work edited by Dr. I. B. Pole Evans, Chief, Division of Botany, Pretoria, and Director of the Botanical Survey of the Union of South Africa marks a new departure in botanical science in this country, in as much as further interest in the study and cultivation of our indigenous plants will be stimulated by making the unique South African flora better known by a series of coloured illustrations accompanied by descriptions. While not an official publication of the Division of Botany, the illustrations and descriptions are the work of members of the staff, and at present the sole credit for its production belongs to the Division. The funds necessary for the appearance of a publication of this nature were donated by private individuals. We sincerely hope that the public will sufficiently appreciate the work by becoming subscribers and so making the publication of future Volumes possible.

The work will be issued every three months, commencing on November 1st. 1920, each part containing ten coloured plates, price 15s. annual subscription 60s. (postage 2s.).

Messrs, L. Reeve & Co., Ltd.,
6 Henrietta Street, Covent Garden,
London.
are the publishers, and
The Speciality Press of South Africa, Ltd.,
P.O. Box 3958, Johannesburg.
P.O. Box 388, Cape Town.
are the South African Agents.

The first part contains illustrations of the following plants:—

Agapanthus umbellatus	Pl. 1.
Aloe globuligemma.	Pl. 2.
Arctotis Fosteri.	Pl. 3.
Cyrtanthus contractus.	Pl. 4.
Gerbera Jamesoni	Pl. 5.
Gladiolus Psittacinus var. *Cooperi.*	Pl. 6.
Leucadendron Stokoei (male).	Pl. 7.
Leucadendron Stokoei (female).	Pl. 8.
Tulbaghia violacea	Pl. 9.
Richardia angustiloba.	Pl. 10.

The American Society of Mammalogists.

We have pleasure in welcoming to biological science the recently formed "American Society of Mammalogists", the headquarters of which are at Washington, D.C. This is the first society of its kind, and as such we tender our congratulations and best wishes for its prosperity and the attainment of its ideals. The first number of its Journal appeared in November, 1919, and in the "Editorial Comment" it is stated that, "Systematic work, life history and habits of mammals, evolution, palaeontology, anatomy and every phase of technical and popular mammalogy are to come within the scope of the society and its publications".

Mammalogy has not, in the past, attracted so great a number of followers as we find in the more aesthetic studies of botany, ornithology and entomology, hence papers upon the subject are scattered amongst journals covering a wide field; yet there are not wanting a great number of technical students, not to mention many sportsmen and others interested in the larger and diurnal mammals, scattered in all parts of the universe, to whom the formation of this society will specially appeal, and it will therefore fill a long-felt need. As the title of

the society indicates, its activities are devoted more particularly to American labourers; but it nevertheless embraces subjects of general interest and importance, as is shown by the pages of its Journal, such as discussions upon classification, lists and reviews of all publications upon mammalogy, and even papers upon exotic mammals. Membership consists of ordinary members elected upon recommendation and contributing an annual subscription of three dollars), honorary members and patrons. Additions to the roll are solicited, and those desirous of joining the society should communicate with the Corresponding Secretary, Dr. Hartley T. Jackson, Biological Survey, Washington, D.C. The society started with a membership of over two hundred and fifty, and when it has become more generally known is sure to add enormously to its numbers, so that its success is assured, as it deserves to be.

The first number of its Journal contains the following papers, covering fifty one pages and two plates:—

Bats from Mount Whitney, by Glover M. Allen.

Criteria for the recognition of Genera and Species, by C. Hart Merriam.

This is a discussion upon the intergradation of species and higher groups and their definition, a subject which has troubled the minds of systematists since the days of Linné and still does so more than ever. It invites discussion, and another point of view is expressed by P. A. T. Taverner in a later number of the Journal.

The Mammals of South-eastern Washington, by Lee Raymond Dice.

Preliminary Notes on African Carnivora, by J. A. Allen.

This article is of special importance to African students. The generic name of *Aonyx* is found to be applicable to the Cape Clawless Otter alone, the Asiatic species commonly associated with it being removed to a new genus *Micraonyx*. New genera are described in OSBORNICTIS, allied to *Genetta*, for *O. piscivora*, a new species, and in

XENOGALE, allied to *Herpestes, Ichcumia* and *Atilax,* for *X. microdon,* another new species, both discoveries due to the explorations of the American Museum Congo Expedition. The generic names of *Mungos* and *Herpestes* are discussed and it is shown that the Banded Mungoose, formerly known by the name of *Crossarchus fasciatus* (Desmarest) should bear the name of *Mungos mungo* (Gmelin), and *Herpestes* (which was replaced by *Mungos* in 1907) is applicable to the thin-tailed mungooses of the ichneumon group.

A New Subspecies of Beaver from North Dakota. By VERNON BAILEY.

Notes on the Fox Squirrels of South-eastern United States. By ARTHUR H. HOWELL.

These are devoted to shorter articles, included amongst which we may note "An easy method of cleaning Skulls", by A. Brazier Howell, and "Why should every specimen be named", by C. Hart Merriam.

Recent Literature, containing reviews and lists of papers upon mammals.

Editorial Comment, containing a brief history of the foundation of the society.

By-laws and Rules of the American Society of Mammalogists.

The second number of the Journal, published in February, 1920, contains fifty-nine pages, two plates and five text-figures. It comprises nine articles, covering the wide field of operations of the Society, besides the shorter papers contained in the General Notes, Recent Literature, Correspondence and Editorial Comment. Of special importance to African students may be mentioned, *"For a study of Life Histories",* by Ernest Thompson Seton, in which the writer advocates schedule methods in order to avoid overlooking important details, and in the "General Notes" a contribution on the *"Technical Names of Two*

Colobus Monkeys", by J. A. Allen. The other articles are all of a high standard, lack of space alone preventing our comment thereupon.

The third number of the first volume, published in May, 1920, contains forty-nine pages, four plates and four text-figures. Besides the contributions on American mammals, of particular interest to us is P. A. Taverner's views on "*The test of the subspecies*", the question raised in the first number of the Journal by Merriam; "*The Fur Situation*", by N. Dearborn, showing that the centre of the fur trade has now shifted to North America, where a national conference was held in February, 1920, at Montreal, on the fur industry and wild life protection in Canada; and a supplementary note on cleaning skulls by A. B. Howell.

A. ROBERTS.

On June 4th. 1920, Mr. J. Forsyth of the Experimental Farm, Glen, brought me a specimen of what appeared to be a blind snake, and stated that he was present and actually saw the animal being voided with the excrement of the pedigree South Devon Cow D.O.A. 48. The specimen was sent to the Museum at Kimberley, where Mr. J. H. Power kindly identified it and declared it to be *Monopeltis capensis,* a legless lizard of the family *Amphisbaenidae.* Except for the head, which was damaged, the animal was intact. How it came into the digestive system of the cow can only be surmised, especially since the lizard lives underground, and it seems remarkable that the animal should have travelled the whole length of the cow's intestines (which according to Hering are about 150 feet long) without having been injured more than was actually the case.

R. BIGALKE.

Before reading Mr. Barker's note on the tending by ants of certain Membracids, I observed the following, which it may be of interest to record:—

On the 16th. December last, whilst on the hills in the neighbourhood of Orange Grove, I noticed a number of ants attending to what appeared, on a cursory glance, to be scattered white scales on the tips of the branches of a wild fig. On looking closer, the scales turned out to be markings on the skin of a caterpillar, which closely resembled the bark of the young tips. The ants were of two species, the common ant of S.A. and a small black one.

By watching them, I was able to discover a number of larvae, large and small, all of which were attended by the ants and apparently took no notice of them.

About the bush were flying one or two butterflies (*Myrina ficedula*) and in a spider's web was a dead specimen. The latter and specimens of the caterpillars were secured, as the tending of the larvae by ants struck me as being so out of the common that I wanted to have them identified.*

C. N. Knox Davies.

CORRESPONDENCE.

Fabre and Parthenogenesis.

Dear Sir,—With all the deference undoubtedly due to Mr. C. P. Dadant, it appears to be clear that in his notes in the American Bee Journal, May 1918, he presumes rather than shows that Fabre in his "Souvenirs Entomologiques" denies the theory of Parthenogenesis in relation to the Hymenoptera. His quotations from the

*In the Cambridge Natural History, Insects vol. II., there is a reference to this remarkable habit amongst the caterpillars of Lycaenidae, to which family *Myrina ficedula* belongs. (*Editor.*)

great French Naturalist refer to the question of the "facultative determination of the sexes—the fertilization or non-fertilization of the eggs of the Queen Bee as they passed through the Oviduct".

This "facultative determination of the sexes" must apply only in the case of a fertilized Queen, and not to the "reproduction by *Virgin* Females by means of eggs."

As a matter of fact Fabre, devotes his third chapter on the Halicti, a family of "burrowing" bees, to the question of Parthenogenesis, and at the conclusion of same states:—

"To sum up, judging by the three species that form the subject of my investigation, the Halicti have two generations a year, one in the Spring, issuing from the Mother who has lived through the Winter after being fecundated in the Autumn, the other in the Summer, the fruit of Parthenogenesis; that is to say, of reproduction by the power of the Mother alone."

Some doubt seemed to have been in Fabre's mind at one time as to whether the same conclusions to which he had come after many years of research amongst the wild bees and wasps would apply also to the Hive Bee, but this doubt was afterwards dispelled as is shown by the following quotation:—

"I..........admit that all the game-hunting and honey-gathering Hymenoptera possess a seminal receptacle, etc.,

"This organ once accepted the German theory becomes applicable to all the Bees and all the Wasps."

Yours faithfully,

SIRIUS.

Note.—The foregoing quotations from J. H. Fabre's writings are taken from Bramble Bees and Others", translated by A. T. de Mattos, F.Z.S.—a collection of all the essays on "Wild Bees", which are to be found in the "Souvenirs Entomologiques".

11 North Broadway, White Plains, N.Y.
November 30, 1919.

Dear Sir,—I am very anxious to get Aquatic Hemiptera in alcohol or other fluid from your region. I have thus far been extremely unsuccessful. I would very much appreciate it if you could possibly secure a small lot, even if if is only half a dozen specimens, and send it to me by sample post, declared as "Sample Insects, No commercial value." I shall, of course, be glad to reimburse you for any expense.

I shall be very glad to co-operate with you, if possible, in any want you may have from this part of the world.

Faithfully yours,
J. R. DE LA TORRE-BUENO.

Owensmouth, Calif.
February 5th. 1920.

Dear Sir,—If you wish to exchange specimen Lepidoptera from your part of the world for California specimens, I would very much like to exchange with you. If you are not interested in the exchange of insects, and know any one in your part who is, I would appreciate the favour if you will forward this letter to them.

Yours very truly,
THOS J. DENNIS.

Referring to *Klaas' Cuckoo* at Despatch near Port Elizabeth, Mr. Fred Holland writes:—

They have returned here earlier than usual this season, and I saw two pairs together on August 9th., which let me approach within ten yards. Later in the season they become much shyer. They usually deposit eggs here, in the Greater Double-collared Sunbirds' nests (Cimiyris afer.), and the greedy young bird keeps its foster parents exceedingly busy always, squeaking lustily and continuously for more worms. A couple of seasons back, one fell out of its nest, so we put it into a cage intending

to try and rear it by hand. To our astonishment however, the sun-birds found it half an hour later, and fed it through the wires for a week until it could fly, when we released it. They continued to feed it on adjacent trees for a few days longer until it flitted. I might add by the way that this is the first occasion that I have seen more than a pair of these cuckoos together.

Obituary.

William Tyson.

This pioneer of biological science in South Africa passed away at Grahamstown on April 14th, 1920, in his seventy-first year. He belonged to that past generation of botanists which laid the foundation of our present knowledge on plant distribution in South Africa. During a period of nearly 45 years in this country, Mr. Tyson made extensive collections of the native flora. His material from East Griqualand, Pondoland and Murraysburg is specially important, containing many species not previously known. The collections were distributed to various public and private institutions, either directly or through the gentlemen who helped him in the identifications of his plants, the late Drs. H. Bolus and P. MacOwan. The most complete set of Tyson's plants is that in the Cape Government Herbarium, and there are good sets also in the Bolus Herbarium, in the Albany Museum, Grahamstown, and at Kew. In preparing the specimens, he was scrupulously careful and neat, and, in the opinion of a competent authority, no collector in South Africa has exceeded Tyson, and few have equalled him in this respect.

The last nine years of his life were spent at Pt. Alfred in enforced seclusion, for physical infirmity entirely pre-

WILLIAM TYSON.

vented an active life. Nevertheless, with the aid of numerous juvenile friends he managed to bring together a very large collection of sea-weeds, the most important of its kind ever made in South Africa. This was distributed in sets to herbariums in all parts of the world. It was for the purpose of completing his fine series of sea-weeds, and at the same time helping generally the newly established Botanical Survey of South Africa, that he undertook what proved to be his final collecting trip: he reached his destination on the Pondoland Coast, but illness prevented much collecting and after a few months he returned to Grahamstown.

Willie Tyson was born at a Wesleyan parsonage in Jamaica, being son of the late Rev. Wm. Tyson. When his father was appointed to Sheffield, young Tyson, then about 11 years old, entered Wesley College, where he did well, taking various prizes. He afterwards became a medical student at the Leeds school, but was unable to complete his studies owing to the onset of an affliction (arthritis) that crippled him for life. This was a great blow: it more or less embittered his outlook throughout life, yet he retained an indomitable energy and great enthusiasm for work in science. He came out to South Africa about 1874 and held various teaching posts at the South African College, Cape Town, at Dale College, King William's Town, and at the Grey Institute, Port Elizabeth. In 1888 he entered the Civil Service of Cape Colony, at first as clerk in the office of the Superintendent of Woods and Forests. This gave him the opportunity of travelling through the colonial forests along with his chief, Cte de Vasselot de Regné. Ten years later he was transferred to the Agricultural Department, and became sub-editor of the Agricultural Journal, which was then edited by Mr. Jas. Hellier. He retired from the service in 1904. In 1910 he held a temporary appointment in the Cape Government Herbarium, and before leaving Cape Town worked for some time in the herbarium of Dr. R. Marloth.

Tyson's interests in Natural History were by no means limited to the plant world. Of late years, he had taken up the study of marine shells, being inspired thereto by the recent monograph on Port Alfred shells by the American authority, P. Bartsch.

He also collected insects and sundry small animals for the Albany Museum, and his room at Port Alfred became the *rendez-vous* of naturalists, where residents and visitors brought material of various kinds for his identification: in this capacity, he usually satisfied his visitors, for he had a good general knowledge of the local fauna, and an exceptionally fine memory for scientific names.

Willie Tyson never grew old: he retained to the last a breezy youthful vivacity and all his mental faculties were unimpaired.

His name is perpetuated in the genus Tysonia (Boraginaceae) described by Dr. Bolus, and also in the many specific names of South African plants which were first discovered by him.

J. H.

Frank Pym.

We much regret to have to record the death of Mr. Frank Pym, on May 6th, 1920, at the early age of 41. The deceased gentleman was well known in Grahamstown, his birthplace, and throughout the Eastern Province, having for twenty-one years held the office of Curator at the Kingwilliamstown Museum after a period of apprenticeship as assistant in the Albany Museum, Grahamstown. In building up the collection of those institutions, Frank Pym acquired a great first-hand knowledge of the fauna of the Eastern Province, much of which unfortunately is now lost to us, for he wrote but little. He was indeed no arm-chair zoologist, nor a compiler of books, though the knowledge he had gained was freely given to those who sought his help, and no colleague ever appealed to him in vain.

FRANK PYM.

He was one of the original members of the Ornithological Society of South Africa, serving for some years on the Council of that body, for Ornithology was his special study. He contributed two papers on 'Birds of the Kaffrarian Frontier' to the Journal of the Society (1909 and 1915), which are noteworthy as the first comprehensive lists published on that fauna: and his name is commemorated in one of the Kaffrarian birds he knew so well, Pym's Coucal.

Mr. Pym had a great reputation as a sportsman, and many of his trophies now adorn the interior of the Kingwilliamstown Museum. Amongst them is a magnificent Buffalo that he shot near Grahamstown, a specimen of melancholy interest inasmuch as the Buffalo is now on the verge of extinction in the Albany district. In order to obtain material for his Museum, he made an expedition into British East Africa in 1910. This was carried out at his own expense and proved to be a great success, although it was on this trip that his system became stricken with the fever from which he suffered at intervals up to the time of his last illness. Another hunting expedition in the Melsetter district in 1913 was not so productive for that very reason; but one of the minor discoveries of the trip was a trapdoor spider that he carefully collected for the present writer who afterwards named it *Moggridgea pymi.*

His record of active service is a good one. He went with Methuen's column during the Anglo-Boer war and was at Magersfontein. When the Great War broke out, he joined the Kalahari Horse, which crossed the desert and entered the enemy's country. Afterwards he volunteered for service overseas with the Heavy Artillery, and in due course experienced the vigors of a training camp in a wet and cold English winter: but the strain proved too much for him, and discharged with a small pension, as no longer fit for active service, he returned to South Africa with health much impaired. This was the be-

ginning of the end, for he never recovered his health, and died eventually at Umkomaas of tuberculosis. He worked at the Museum almost to the last, and, besides, held various other offices in an honorary capacity, being secretary to the Frontier Trout Acclimatisation Society, and local secretary to the Association for Advancement of Science in connection with the Kingwilliamstown meeting of that body.

Frank Pym had many friends in all circles of society for his unfailing courtesy and bright cheerful disposition appealed to all who had the privilege to know him. He was essentially a gentleman, and came of a good stock, being directly descended from the historic John Pym of Bedfordshire.

J. H.

Lieut. Claude O. Finch-Davies.

Members of the Society will learn with deep regret of the death, at Cape Town, on the 3rd August, 1920, of Lieut. Claude G. Finch-Davies, of the 1st South African Mounted Riflemen. The late Mr. Finch-Davies, as a sergeant in the Cape Mounted Riflemen (subsequently merged into the S.A.M.R.) was a member of the South African Ornithological Union from 1907, to the Journal of which several papers on the birds of Pondoland and East Griqualand were contributed by him. While stationed in East Griqualand, he became famous for his ability as a bird artist, the beautiful illustrations in Horsbrugh's "Game Birds of South Africa", being by his hand. In 1914 he was given a commission in the S.A.M.R., with that body taking part in the military operations against the Germans in South West Africa and subsequently in quelling the Ovambo rising. These operations carried him into new fields, of which he took full advantage, several important papers on the birds of this area soon after appearing from his pen. Latterly he devoted much time to a study of the birds of prey, which had

always been his favourite subject and which he intended to monograph, to that end preparing innumerable coloured figures from specimens secured by himself or which he was able to borrow. He was particularly interested in plumage variations due to age or sex of this group, and had a knowledge of his subject which only the keenest specialist is able to acquire. He was also a member of the British Ornithological Union, and as such contributed several important papers on South African birds, notably, quite recently, upon the birds of prey and field observations thereon. It is sincerely to be hoped that the great labour he expended on his favourite subject will not be lost and that it will be possible to have published the completed coloured figures and his notes upon the species. In the death of Mr. Finch-Davies, S. Africa loses one of its keenest ornithologists, one who combined the rare qualities of a field naturalist, bird artist and student.

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Vol. II. No. 1. MARCH 1920. Price 7/6.

THE

South African Journal

OF

Natural History

being

the official organ of the

SOUTH AFRICAN BIOLOGICAL SOCIETY

with which is incorporated the Journal of

The South African Ornithologists' Union.

PUBLISHED BY

THE SOCIETY IN PRETORIA, SOUTH AFRICA.

LONDON AGENTS:

WITHERBY & CO., 326 HIGH HOLBORN, W.C. 1.

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The S.A. Biological Society.

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The objects of the Society are:—

(*a*) To advance the study of biological science and to give all possible assistance to those in South Africa, who are interested in the study of Natural History.

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The S.A. Biological Society.

Vol. II. No. 2 SEPTEMBER 1920. Price 7/6.

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London Agents:

WITHERBY & CO. 326 HIGH HOLBORN, W.C.1.

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The S.A. Biological Society.

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The objects of the Society are:—

(*a*) To advance the study of biological science and to give all possible assistance to those in South Africa, who are interested in the study of Natural History.

(*b*) To publish a Journal of Biology and Natural History, together with the transactions of the Society.

(*c*) To advocate the preservation of the monuments of nature.

(d) To hold scientific congresses from time to time in various centres.

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